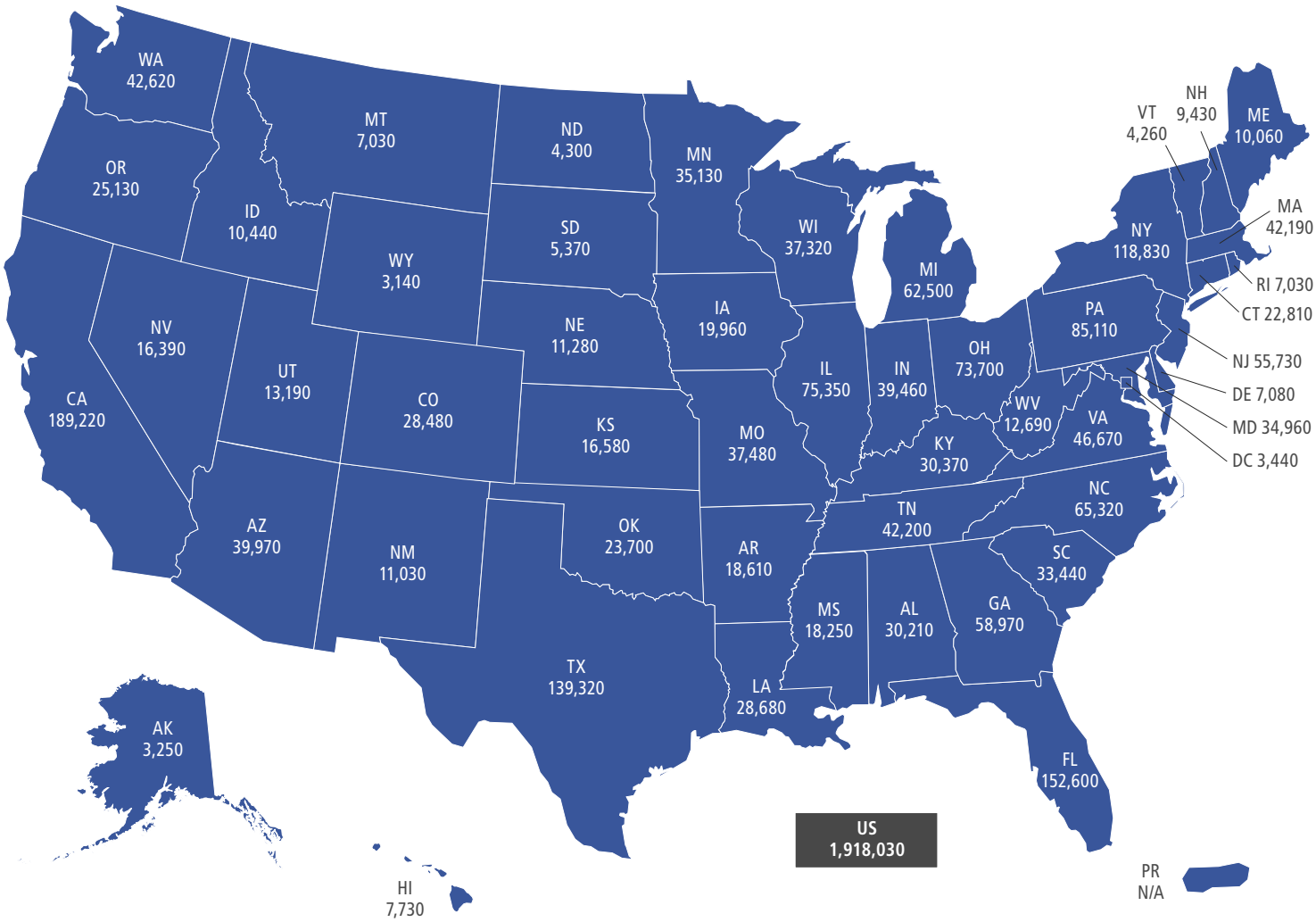
Cancer Facts & Figures 2022



Estimated number of new cancer cases for 2022, excluding basal cell and squamous cell skin cancers and in situ carcinomas except urinary bladder. Estimates are not available for Puerto Rico.
Note: Incidence counts are model-based projections and should be interpreted with caution. State estimates may not equal US total due to rounding.

Special Section: Cancer in the American Indian and Alaska Native Population

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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 that can result in death if not treated. Although the causes of cancer development are not completely understood, numerous factors are known to increase risk, including many that are potentially modifiable (e.g., tobacco use and excess body weight) and others that are not (e.g., inherited genetic mutations). These risk factors may act simultaneously or in sequence to initiate and/or promote cancer growth.

Can Cancer Be Prevented?

A substantial proportion of cancers could be prevented, including all cancers caused by tobacco use and other unhealthy behaviors. Excluding non-melanoma skin cancer, at least 42% of newly diagnosed cancers in the US – about 805,600 cases in 2022 – are potentially avoidable, including the 19% of cancers caused by smoking and at least 18% caused by a combination of excess body weight, alcohol consumption, poor nutrition, and physical inactivity. Certain cancers caused by infectious agents, such as human papillomavirus (HPV), hepatitis B virus (HBV), hepatitis C virus (HCV), and *Helicobacter pylori* (*H. pylori*), could be prevented through behavioral changes or vaccination to prevent infection, or by treating the infection. Many of the more than 5 million skin cancers diagnosed annually could be prevented by protecting skin from excessive sun exposure and not using indoor tanning devices.

Screening can help prevent colorectal and cervical cancers by detecting and removing precancers in the colon, rectum, and uterine cervix. Screening can also detect these and some other cancers early, when treatment is often less intensive and more successful. Screening is known to reduce mortality for cancers of the breast, colon, rectum, cervix, lung (among people with a history of heavy smoking), and prostate. In addition, being aware of changes in the body (such as a new mole or lump under the skin) and bringing these to the attention of a health care professional can also result in the earlier detection of cancer. For complete cancer screening guidelines, see page 77.

How Many People Alive Today Have Ever Had Cancer?

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

How Many New Cases and Deaths Are Expected to Occur in 2022?

A little over 1.9 million new cancer cases are expected to be diagnosed in the US in 2022 (Table 1). This estimate excludes basal cell and squamous cell skin cancers, which are not required to be reported to cancer registries, and carcinoma in situ (noninvasive cancer) except for urinary bladder. Table 2 provides estimated new cancer cases in 2022 by state.

Approximately 609,360 deaths from cancer are expected in the US in 2022 (Table 1), which is 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 provides estimated cancer deaths by state in 2022.

Importantly, these estimates are based on reported cancer incidence and mortality through 2018 and 2019, respectively, and thus do not account for the unknown impact of coronavirus disease 2019 (COVID-19) on cancer diagnoses and deaths. However, it is clear already that the disruption of health services resulted in millions of people who missed or postponed appointments for cancer screening or follow-up of abnormal results or new symptoms, as well as patients already diagnosed who experienced treatment delays and/or modifications. The consequences of this interruption in care will become evident in our cancer statistics over the next several years to come.

How Much Progress Has Been Made Against Cancer?

Substantial progress has been made against cancer in recent decades. The best measure of this progress is cancer death rates (also referred to as mortality rates) because they are less affected by changes in detection practices than incidence (new diagnoses) and survival rates. The overall age-adjusted cancer death rate rose during most of the 20th century, peaking in 1991 at 215 cancer deaths per 100,000 people, mainly because of the smoking epidemic. As of 2019, the rate had dropped to 146 per 100,000 – a decline of 32% – mostly because of reductions in smoking and advances in early detection and treatment for some cancers. The decline in the death rate translates into nearly 3.5 million fewer cancer deaths from 1991 to 2019, largely driven by progress against the four most common cancer types – lung, colorectal, breast, and prostate (Figure 1 and Figure 2).

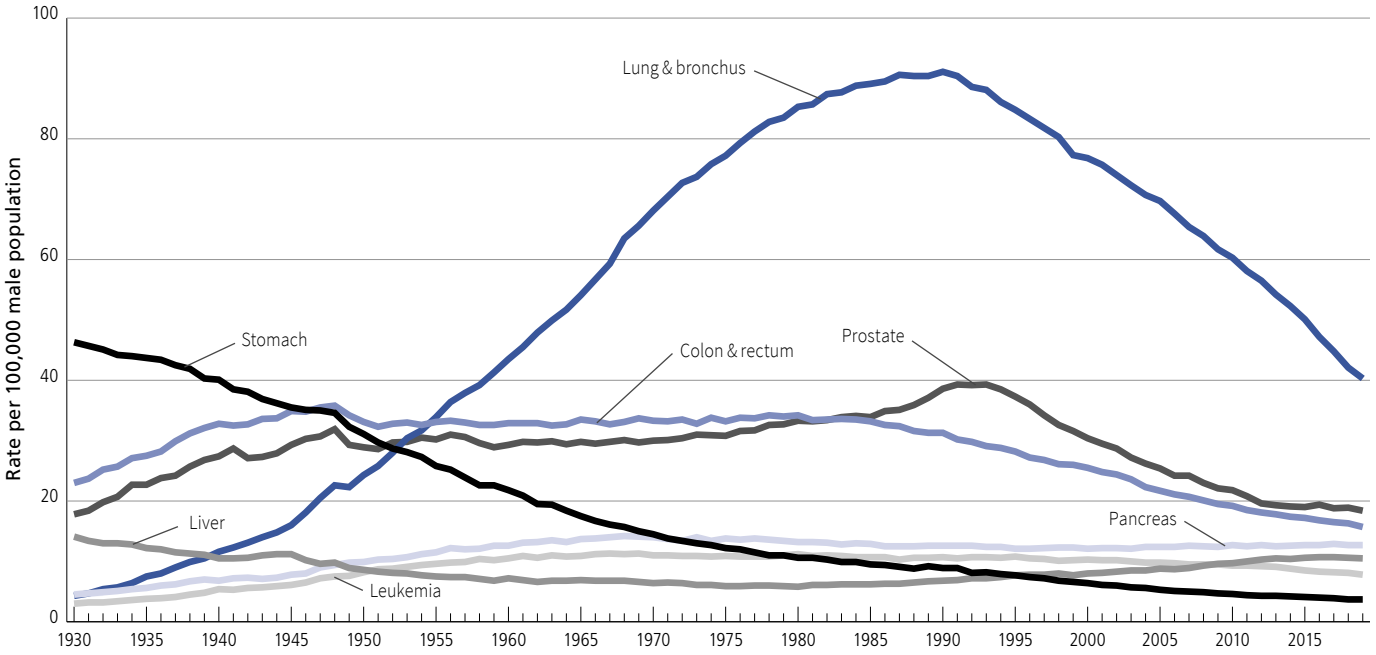
Do Cancer Incidence and Death Rates Vary by State?

Variations in cancer rates differ by cancer type, with the largest for lung cancer, reflecting vast historical and continuing differences in smoking prevalence. Table 4 and Table 5 provide average annual incidence and death rates for selected cancer types by state.

Who Is at Risk of Developing Cancer?

Everyone is at risk of developing cancer, although the likelihood increases greatly with age; 80% of the people diagnosed with cancer in the US are 55 years of age or older and 57% are 65 or older. Certain behaviors and other modifiable factors also increase risk, such as smoking, having excess body weight, drinking alcohol, and eating an unhealthy diet. In the US, an estimated 40 out of 100 men and 39 out of 100 women will develop cancer during their lifetime (Table 6). However, these probabilities are based on cancer occurrence in the general population and may differ in individuals because of variations in

Figure 1. Trends in Age-adjusted Cancer Death Rates* by Site, Males, US, 1930-2019



*Per 100,000, age adjusted to the 2000 US standard population. Note: Due to changes in ICD coding, numerator information has changed over time. Rates for cancers of the liver, lung and bronchus, and colon and rectum are affected by these coding changes.

Source: US Mortality Volumes 1930 to 1959, US Mortality Data 1960 to 2019, National Center for Health Statistics, Centers for Disease Control and Prevention.

exposures (e.g., smoking), family history, and/or genetic susceptibility. A family history of cancer is thought to primarily reflect inheritance of genetic variations that confer slight-to-moderate increased risk in conjunction with shared exposures to lifestyle/environmental factors among family members. Inheritance of genetic alterations that confer a very high risk occurs much less frequently.

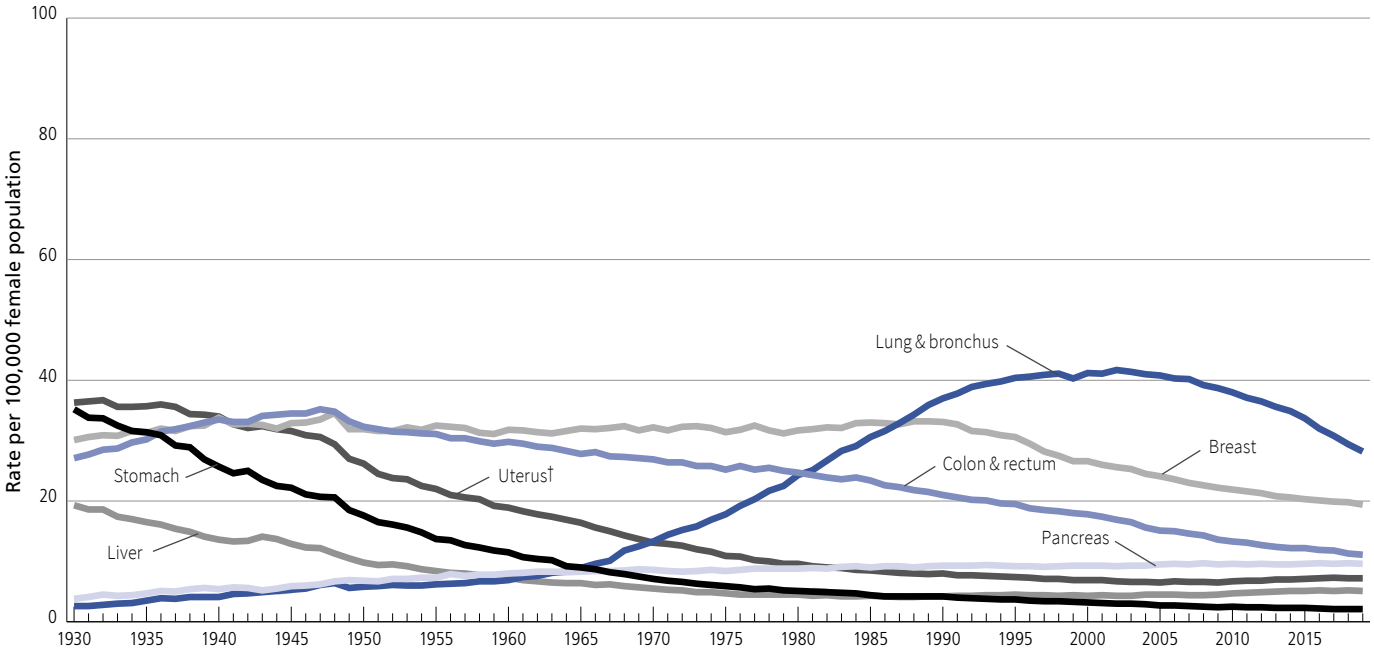
Relative risk is the strength of the relationship between exposure to a given risk factor and cancer. It is measured by comparing the rate of cancer in a group of people with a certain exposure or trait to the rate in a group of people without this characteristic. For example, individuals who smoke cigarettes are about 25 times more likely to develop lung cancer than people who never smoked, so the relative risk of lung cancer among people who smoke is 25. Most relative risks are not this large; for example, the relative risk of breast cancer among women who have a mother, sister, or daughter with a history of breast cancer is about 2. However, even exposures associated with a relatively small excess risk can have a large influence on the number of cancers diagnosed in the population if they are common (e.g., excess body weight).

What Percentage of People Survive Cancer?

Cancer survival is typically described in terms of relative survival, which is a measure of life expectancy among cancer patients compared to that among the general population of the same age, race, and sex. The 5-year relative survival rate for all cancers combined has increased substantially since the early 1960s, from 39% to 68% among White people and from 27% to 63% among Black people. Improvements in survival (Table 7) reflect advances in treatment, as well as earlier diagnosis for some cancers. Survival varies greatly by cancer type and stage (Table 8), as well as age at diagnosis.

Relative survival provides some indication about the average experience of cancer patients, but rates should be interpreted with caution for several reasons. First, they

Figure 2. Trends in Age-adjusted Cancer Death Rates* by Site, Females, US, 1930-2019



*Per 100,000, age adjusted to the 2000 US standard population. Rates exclude deaths in Puerto Rico and other US territories. †Uterus refers to uterine cervix and uterine corpus combined. Note: Due to changes in ICD coding, numerator information has changed for cancers of the liver, lung and bronchus, colon and rectum, and uterus.

Source: US Mortality Volumes 1930 to 1959, US Mortality Data 1960 to 2019, National Center for Health Statistics, Centers for Disease Control and Prevention.

Table 1. Estimated Number* of New Cancer Cases and Deaths by Sex, US, 2022

	Estimated New Cases			Estimated Deaths		
	Both sexes	**Male**	**Female**	**Both sexes**	**Male**	**Female**
All sites	1,918,030	983,160	934,870	609,360	322,090	287,270
Oral cavity & pharynx	54,000	38,700	15,300	11,230	7,870	3,360
Tongue	17,860	12,880	4,980	2,790	1,830	960
Mouth	14,490	8,490	6,000	3,020	1,810	1,210
Pharynx	19,270	15,670	3,600	3,980	3,140	840
Other oral cavity	2,380	1,660	720	1,440	1,090	350
Digestive system	343,040	193,350	149,690	171,920	99,940	71,980
Esophagus	20,640	16,510	4,130	16,410	13,250	3,160
Stomach	26,380	15,900	10,480	11,090	6,690	4,400
Small intestine	11,790	6,290	5,500	1,960	1,110	850
Colon & rectum†	151,030	80,690	70,340	52,580	28,400	24,180
Colon	106,180	54,040	52,140			
Rectum	44,850	26,650	18,200			
Anus, anal canal, & anorectum	9,440	3,150	6,290	1,670	740	930
Liver & intrahepatic bile duct	41,260	28,600	12,660	30,520	20,420	10,100
Gallbladder & other biliary	12,130	5,710	6,420	4,400	1,830	2,570
Pancreas	62,210	32,970	29,240	49,830	25,970	23,860
Other digestive organs	8,160	3,530	4,630	3,460	1,530	1,930
Respiratory system	254,850	131,450	123,400	135,360	72,770	62,590
Larynx	12,470	9,820	2,650	3,820	3,070	750
Lung & bronchus	236,740	117,910	118,830	130,180	68,820	61,360
Other respiratory organs	5,640	3,720	1,920	1,360	880	480
Bones & joints	3,910	2,160	1,750	2,100	1,180	920
Soft tissue (including heart)	13,190	7,590	5,600	5,130	2,740	2,390
Skin (excluding basal & squamous)	108,480	62,820	45,660	11,990	8,060	3,930
Melanoma of the skin	99,780	57,180	42,600	7,650	5,080	2,570
Other nonepithelial skin	8,700	5,640	3,060	4,340	2,980	1,360
Breast	290,560	2,710	287,850	43,780	530	43,250
Genital system	395,600	280,470	115,130	68,260	35,430	32,830
Uterine cervix	14,100		14,100	4,280		4,280
Uterine corpus	65,950		65,950	12,550		12,550
Ovary	19,880		19,880	12,810		12,810
Vulva	6,330		6,330	1,560		1,560
Vagina & other genital, female	8,870		8,870	1,630		1,630
Prostate	268,490	268,490		34,500	34,500	
Testis	9,910	9,910		460	460	
Penis & other genital, male	2,070	2,070		470	470	
Urinary system	164,190	114,490	49,700	31,990	21,680	10,310
Urinary bladder	81,180	61,700	19,480	17,100	12,120	4,980
Kidney & renal pelvis	79,000	50,290	28,710	13,920	8,960	4,960
Ureter & other urinary organs	4,010	2,500	1,510	970	600	370
Eye & orbit	3,360	1,790	1,570	410	220	190
Brain & other nervous system	25,050	14,170	10,880	18,280	10,710	7,570
Endocrine system	47,050	13,620	33,430	3,330	1,650	1,680
Thyroid	43,800	11,860	31,940	2,230	1,070	1,160
Other endocrine	3,250	1,760	1,490	1,100	580	520
Lymphoma	89,010	48,690	40,320	21,170	12,250	8,920
Hodgkin lymphoma	8,540	4,570	3,970	920	550	370
Non-Hodgkin lymphoma	80,470	44,120	36,350	20,250	11,700	8,550
Myeloma	34,470	19,100	15,370	12,640	7,090	5,550
Leukemia	60,650	35,810	24,840	24,000	14,020	9,980
Acute lymphocytic leukemia	6,660	3,740	2,920	1,560	880	680
Chronic lymphocytic leukemia	20,160	12,630	7,530	4,410	2,730	1,680
Acute myeloid leukemia	20,050	11,140	8,910	11,540	6,730	4,810
Chronic myeloid leukemia	8,860	5,120	3,740	1,220	670	550
Other leukemia‡	4,920	3,180	1,740	5,270	3,010	2,260
Other & unspecified primary sites‡	30,620	16,240	14,380	47,770	25,950	21,820

*Rounded to the nearest 10; cases exclude basal cell and squamous cell skin cancer and in situ carcinoma except urinary bladder. About 51,400 cases of female breast ductal carcinoma in situ and 97,920 cases of melanoma in situ will be diagnosed in 2022. †Death estimates for are only available for colon and rectal cancers 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 2004-2018 incidence data reported by the North American Association of Central Cancer Registries (NAACCR). Estimated deaths are based on 2005-2019 US mortality data, National Center for Health Statistics, Centers for Disease Control and Prevention.

Table 2. Estimated Number* of New Cases for Selected Cancers by State, US, 2022

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	30,210	4,280	240	2,510	800	780	4,280	1,480	1,000	4,650	1,140
Alaska	3,250	530	†	320	100	90	380	100	120	460	160
Arizona	39,970	6,110	290	3,150	1,320	1,090	4,610	3,110	1,680	4,940	1,900
Arkansas	18,610	2,440	160	1,530	570	520	2,820	900	690	2,510	710
California	189,220	31,720	1,640	15,970	7,110	5,630	17,450	10,260	8,500	26,890	7,620
Colorado	28,480	4,730	190	2,140	940	870	2,550	1,850	1,140	4,030	1,220
Connecticut	22,810	3,550	120	1,550	830	680	2,760	1,050	950	3,310	1,110
Delaware	7,080	1,010	†	500	250	230	910	470	280	940	310
Dist. of Columbia	3,440	620	†	250	160	90	370	70	120	580	110
Florida	152,600	20,920	1,230	11,490	4,860	6,630	19,560	9,650	7,980	20,680	6,890
Georgia	58,970	9,170	490	4,970	1,730	1,860	7,700	3,640	2,140	9,150	2,100
Hawaii	7,730	1,430	60	700	370	210	890	530	330	940	300
Idaho	10,440	1,490	70	750	320	330	1,100	940	440	1,480	500
Illinois	75,350	11,340	530	6,260	2,730	2,190	9,440	3,860	3,060	10,520	3,110
Indiana	39,460	5,600	290	3,290	1,340	1,160	5,920	2,250	1,520	5,020	1,720
Iowa	19,960	2,770	110	1,570	690	750	2,530	1,250	880	2,690	870
Kansas	16,580	2,410	100	1,510	540	530	2,190	920	680	2,550	680
Kentucky	30,370	3,950	200	2,600	930	850	4,990	1,680	1,110	3,840	1,280
Louisiana	28,680	3,970	230	2,440	730	800	3,800	1,010	1,070	4,170	1,020
Maine	10,060	1,420	†	700	370	300	1,640	520	420	1,180	580
Maryland	34,960	5,640	240	2,540	1,400	970	4,150	1,670	1,350	5,380	1,310
Massachusetts	42,190	6,710	210	2,940	1,530	1,120	5,600	1,900	1,780	5,670	2,030
Michigan	62,500	8,900	370	4,680	2,270	1,850	8,720	3,180	2,670	9,240	2,880
Minnesota	35,130	4,950	160	2,420	1,190	1,390	3,980	1,860	1,550	4,290	1,530
Mississippi	18,250	2,510	150	1,680	490	450	2,810	730	580	2,970	600
Missouri	37,480	5,560	250	2,970	1,290	1,160	5,690	1,690	1,480	4,830	1,550
Montana	7,030	1,000	†	510	200	240	820	510	300	1,100	340
Nebraska	11,280	1,600	70	960	360	380	1,330	630	460	1,680	480
Nevada	16,390	2,570	160	1,430	510	510	2,030	770	700	2,230	800
New Hampshire	9,430	1,360	†	670	370	260	1,270	610	410	1,280	550
New Jersey	55,730	8,410	420	4,260	2,280	1,730	5,980	2,300	2,420	8,580	2,560
New Mexico	11,030	1,700	90	890	410	350	940	670	450	1,430	400
New York	118,830	17,800	870	8,950	4,730	4,010	14,050	3,960	5,240	17,960	5,450
North Carolina	65,320	10,220	440	4,760	2,130	2,120	8,760	3,760	2,450	9,550	2,670
North Dakota	4,300	590	†	340	120	170	510	230	180	600	200
Ohio	73,700	10,610	480	5,870	2,760	1,910	10,430	4,110	2,870	9,530	3,260
Oklahoma	23,700	3,280	210	1,900	660	710	3,390	1,180	870	2,900	870
Oregon	25,130	4,070	160	1,850	860	680	2,990	1,640	1,090	3,250	1,200
Pennsylvania	85,110	12,220	500	6,610	3,270	2,600	11,170	3,540	3,740	11,740	4,130
Rhode Island	7,030	1,020	†	490	260	240	980	320	300	1,030	360
South Carolina	33,440	5,170	240	2,570	1,080	1,030	4,560	1,970	1,260	5,110	1,310
South Dakota	5,370	750	†	430	160	180	660	320	220	810	230
Tennessee	42,200	6,040	330	3,420	1,280	1,230	6,200	1,940	1,630	5,800	1,690
Texas	139,320	21,040	1,500	11,780	4,140	4,750	14,790	5,020	5,590	17,850	4,470
Utah	13,190	1,960	80	900	480	420	780	1,610	550	2,130	480
Vermont	4,260	630	†	300	170	130	590	290	190	490	220
Virginia	46,670	7,600	310	3,610	1,590	1,320	5,900	2,240	1,880	7,150	1,830
Washington	42,620	7,020	280	3,120	1,310	1,320	4,880	2,510	1,890	5,670	1,930
West Virginia	12,690	1,630	80	1,080	490	400	2,050	660	520	1,550	640
Wisconsin	37,320	5,380	200	2,680	1,380	1,320	4,500	2,170	1,590	5,590	1,730
Wyoming	3,140	460	†	240	100	90	330	250	130	590	160
United States	**1,918,030**	**287,850**	**14,100**	**151,030**	**65,950**	**60,650**	**236,740**	**99,780**	**80,470**	**268,490**	**81,180**

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

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

Table 3. Estimated Number* of Deaths for Selected Cancers by State, US, 2022

State	All sites	Brain/ nervous system	Female breast	Colon & rectum	Leukemia	Liver‡	Lung & bronchus	Non-Hodgkin lymphoma	Ovary	Pancreas	Prostate
Alabama	10,520	320	730	910	340	510	2,650	270	210	830	480
Alaska	1,030	†	70	110	†	70	220	†	†	80	60
Arizona	13,200	410	910	1,210	540	710	2,280	410	310	1,120	820
Arkansas	6,460	190	390	560	210	310	1,770	190	120	450	430
California	60,970	2,070	4,690	5,470	2,340	3,680	9,660	2,150	1,390	5,080	4,130
Colorado	8,170	310	670	710	320	440	1,330	260	200	680	580
Connecticut	6,400	210	420	470	320	330	1,360	220	150	580	420
Delaware	2,200	50	160	160	100	120	530	80	50	190	100
Dist. of Columbia	1,010	†	100	90	†	80	150	†	†	100	70
Florida	47,540	1,360	3,150	4,110	1,980	2,330	10,440	1,560	1,010	3,820	2,720
Georgia	18,750	500	1,410	1,590	650	930	4,180	540	410	1,450	1,070
Hawaii	2,590	60	210	240	90	160	540	100	†	240	130
Idaho	3,240	130	250	270	140	120	590	120	80	270	200
Illinois	23,200	610	1,730	2,110	900	1,100	5,140	780	530	2,010	1,160
Indiana	13,570	380	880	1,160	520	640	3,470	450	190	1,070	770
Iowa	6,470	190	380	540	270	250	1,450	240	140	520	390
Kansas	5,660	180	380	480	250	270	1,350	220	110	420	280
Kentucky	9,740	290	640	880	390	390	2,730	320	170	740	320
Louisiana	9,630	240	690	880	330	570	2,310	290	170	740	470
Maine	3,440	110	190	230	120	130	860	120	60	260	170
Maryland	11,030	290	840	980	450	510	2,230	340	240	880	680
Massachusetts	12,520	440	760	990	510	620	2,760	410	290	1,110	700
Michigan	21,260	600	1,390	1,700	820	870	5,000	740	440	1,780	1,000
Minnesota	10,340	310	640	790	460	490	1,950	460	210	840	660
Mississippi	6,790	200	450	660	230	380	1,820	160	110	520	410
Missouri	13,050	350	820	1,070	500	590	3,200	410	250	990	680
Montana	2,160	70	150	170	80	110	370	70	†	170	140
Nebraska	3,550	120	250	320	170	100	670	110	70	290	170
Nevada	5,730	130	440	470	230	300	1,170	240	120	430	410
New Hampshire	2,880	90	180	210	110	120	710	90	70	320	160
New Jersey	15,710	510	1,210	1,380	660	790	2,930	440	350	1,390	750
New Mexico	3,830	120	290	330	130	300	560	120	100	290	240
New York	32,230	980	2,460	2,670	1,340	1,280	6,660	1,170	830	2,930	1,720
North Carolina	20,480	470	1,450	1,630	800	1,000	4,750	630	390	1,590	1,120
North Dakota	1,310	†	70	110	60	50	300	50	†	100	70
Ohio	25,120	720	1,700	2,110	990	1,040	5,900	830	380	2,090	1,370
Oklahoma	8,620	240	570	770	310	450	2,260	280	180	580	450
Oregon	8,460	260	580	650	330	470	1,670	300	170	700	520
Pennsylvania	27,260	820	1,900	2,310	1,110	1,210	5,990	940	590	2,330	1,470
Rhode Island	2,170	70	130	160	90	140	480	70	†	190	100
South Carolina	10,850	340	770	890	430	590	2,560	300	180	880	630
South Dakota	1,740	70	110	160	70	80	410	60	†	150	80
Tennessee	14,390	410	1,040	1,250	550	690	3,680	460	260	1,060	750
Texas	43,490	1,280	3,440	4,280	1,610	2,790	8,270	1,400	910	3,390	2,260
Utah	3,540	150	310	310	180	160	470	130	100	290	360
Vermont	1,460	50	80	120	50	80	330	50	†	120	80
Virginia	15,280	440	1,150	1,370	610	710	3,470	490	350	1,270	940
Washington	13,270	470	940	1,110	530	730	2,720	470	320	1,070	850
West Virginia	4,460	120	290	440	190	170	1,190	170	80	340	190
Wisconsin	11,570	370	720	900	500	510	2,500	460	240	980	740
Wyoming	1,000	†	70	80	†	60	210	†	†	90	60
United States	**609,360**	**18,280**	**43,250**	**52,580**	**24,000**	**30,520**	**130,180**	**20,250**	**12,810**	**49,830**	**34,500**

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

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

Table 4. Incidence Rates for Selected Cancers by State, US, 2014-2018

	All sites		Breast	Uterine cervix	Colon & rectum*		Lung & bronchus		Non-Hodgkin lymphoma		Prostate
State	**Male**	**Female**	**Female**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
Alabama	515.2	404.1	121.4	9.4	47.8	35.6	81.9	49.6	19.5	12.9	121.9
Alaska	440.7	403.8	121.9	7.9	43.9	37.5	62.6	48.5	20.1	13.5	88.4
Arizona	410.3	368.5	114.2	6.5	35.8	26.7	49.2	41.6	18.5	12.7	79.6
Arkansas	543.5	430.9	119.5	9.5	49.5	36.0	93.7	62.9	22.1	14.8	117.1
California	428.4	387.4	121.8	7.3	38.6	29.2	44.9	36.9	22.1	15.1	92.3
Colorado	415.5	387.3	129.0	6.3	34.6	27.3	43.1	38.5	20.5	14.1	92.3
Connecticut	499.5	443.6	140.2	5.8	37.9	29.1	62.8	54.2	25.3	17.2	114.4
Delaware	524.9	447.2	133.7	8.3	41.2	31.2	71.4	59.7	23.7	16.1	122.8
Dist. of Columbia	456.1	410.2	140.4	8.2	40.4	32.6	49.0	42.1	18.7	11.8	130.3
Florida	499.9	431.0	120.4	9.1	40.3	30.2	65.2	50.1	27.6	19.7	95.2
Georgia	531.4	424.1	128.4	8.0	46.4	33.4	76.2	50.0	22.3	14.8	126.6
Hawaii	439.8	402.1	139.6	6.9	44.5	33.1	54.5	35.5	19.1	13.1	95.6
Idaho	478.2	420.2	128.8	7.1	37.5	29.7	54.2	45.1	23.6	15.7	108.5
Illinois	503.6	444.5	133.7	7.7	47.1	34.7	71.8	56.7	23.3	16.4	111.5
Indiana	499.0	431.5	124.5	8.3	46.4	34.7	82.2	60.5	22.2	15.5	96.5
Iowa	527.1	455.5	132.6	8.0	46.2	36.4	72.9	54.8	26.0	17.3	112.1
Kansas	495.5	433.5	131.6	8.3	43.4	33.0	63.0	50.0	23.5	15.8	111.0
Kentucky	568.4	484.5	127.6	9.8	53.7	38.7	104.6	76.9	23.7	16.5	105.1
Louisiana	556.7	427.3	127.4	9.4	51.0	37.1	80.6	52.2	23.1	15.6	134.7
Maine	504.9	458.0	127.2	5.6	37.8	30.2	77.5	66.7	25.5	16.7	92.6
Maryland	493.1	426.1	132.2	6.7	39.5	30.9	60.9	50.9	21.4	15.2	128.1
Massachusetts	486.3	440.6	136.9	5.5	38.0	28.7	64.5	58.1	23.6	15.7	107.7
Michigan	487.2	422.6	123.1	6.8	40.1	31.6	70.5	57.1	23.7	16.2	107.3
Minnesota	506.1	445.5	134.2	5.4	40.2	31.1	60.3	51.7	26.4	17.1	110.5
Mississippi	549.8	418.9	120.9	9.5	54.6	39.8	95.6	57.6	20.6	14.0	131.5
Missouri	486.8	430.0	130.2	8.1	44.4	33.1	81.7	62.3	22.4	15.2	93.0
Montana	496.7	435.8	135.4	7.0	42.0	29.6	52.0	50.9	22.2	14.9	124.2
Nebraska	508.7	440.3	130.5	7.6	45.9	36.6	63.4	50.3	23.8	17.0	123.3
Nevada†	395.5	374.1	110.4	8.6	40.2	30.0	49.2	48.6	17.4	12.1	80.9
New Hampshire	509.4	460.1	143.1	5.1	39.7	29.0	65.7	60.8	24.4	17.2	109.2
New Jersey	531.8	459.2	137.2	7.9	44.4	33.4	59.5	51.2	26.5	18.4	134.5
New Mexico	390.3	363.2	111.0	8.5	36.5	28.3	42.3	33.0	17.1	13.2	82.7
New York	528.0	454.8	133.9	7.7	42.4	31.5	64.8	53.2	26.0	18.1	126.5
North Carolina	521.1	433.3	136.5	7.1	40.6	30.7	80.2	55.9	21.5	14.6	119.3
North Dakota	490.1	428.2	129.4	6.0	45.6	34.3	64.4	53.2	21.9	15.6	118.2
Ohio	505.2	443.7	129.6	7.9	45.3	34.7	78.7	58.7	23.4	15.8	107.2
Oklahoma	488.8	424.3	124.2	9.5	46.3	33.9	78.4	57.4	20.6	15.5	95.7
Oregon	450.3	419.0	128.0	7.0	36.4	29.0	56.0	50.2	22.4	15.5	93.3
Pennsylvania	515.6	459.0	132.2	7.3	44.4	33.3	71.5	56.2	24.8	17.8	104.3
Rhode Island	503.8	456.8	139.8	7.3	36.9	27.5	75.3	64.6	24.0	16.1	105.1
South Carolina	502.6	411.0	129.9	7.8	41.9	30.8	77.6	51.4	20.4	13.7	113.0
South Dakota	500.9	430.3	124.8	6.9	46.4	33.9	64.4	53.0	23.2	16.3	118.3
Tennessee	523.1	425.0	123.1	8.5	45.1	33.5	89.5	62.2	21.9	14.5	113.9
Texas	454.4	381.2	114.2	9.3	44.0	30.2	59.4	41.7	21.0	14.2	97.6
Utah	444.5	376.2	115.5	5.4	30.5	24.8	30.4	22.5	22.6	14.5	115.0
Vermont	477.0	447.0	132.4	3.9	35.9	30.6	66.0	55.9	22.9	15.7	92.1
Virginia	439.2	393.6	126.4	6.1	37.9	29.7	63.2	48.4	20.5	13.9	98.0
Washington	469.3	426.5	133.5	6.7	37.3	29.5	56.9	49.5	23.6	16.0	98.1
West Virginia	513.7	464.1	118.7	9.7	50.5	38.9	91.3	69.3	22.6	16.5	94.3
Wisconsin	509.5	440.5	132.9	6.6	39.1	30.2	65.7	53.6	25.7	17.4	112.6
Wyoming	429.4	382.0	114.3	7.4	33.8	28.5	44.0	40.5	20.2	13.3	111.4
Puerto Rico‡	410.0	334.3	95.2	12.9	48.8	33.6	22.6	11.5	17.8	12.4	144.3
United States	**487.9**	**423.0**	**126.9**	**7.7**	**42.1**	**31.6**	**65.8**	**50.8**	**23.1**	**15.9**	**106.4**

Rates are per 100,000, age adjusted to the 2000 US standard population. *Colorectal cancer incidence rates exclude appendix, with the exception of NV. †Data for this state are not included in US combined rates because either the registry did not consent or incidence data did not meet high-quality standards for all years during 2014-2018 according to the North American Association of Central Cancer Registries (NAACCR). Rates for this state are based on data published in NAACCR's Cancer in North America, Volume II. ‡Data for Puerto Rico are not included in US combined rates for comparability to previously published US rates.

Source: NAACCR, 2021. Data are collected by cancer registries participating in the National Cancer Institute's SEER program and the Centers for Disease Control and Prevention's National Program of Cancer Registries.

Table 5. Death Rates for Selected Cancers by State, US, 2015-2019

	All sites		Breast	Colon & rectum		Lung & bronchus		Non-Hodgkin lymphoma		Pancreas		Prostate
State	**Male**	**Female**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
Alabama	212.1	139.2	21.4	18.6	12.4	62.6	33.9	6.6	3.6	13.7	10.2	20.6
Alaska	172.0	131.2	17.8	15.7	13.8	38.9	30.7	6.8	4.9	11.6	8.8	19.1
Arizona	159.0	116.1	18.3	15.0	9.9	34.3	25.8	5.8	3.4	11.9	8.8	17.2
Arkansas	212.3	145.2	19.5	18.5	12.9	64.4	39.8	6.9	3.8	12.8	9.4	18.8
California	161.5	120.4	19.1	14.3	10.6	31.6	22.9	6.5	3.9	11.8	9.1	19.8
Colorado	154.6	114.7	18.7	13.1	10.0	28.2	23.1	6.0	3.4	10.8	8.3	21.2
Connecticut	164.6	120.3	17.3	12.6	8.8	36.2	28.1	6.8	3.8	12.4	9.7	18.0
Delaware	192.7	138.1	21.3	15.6	11.1	49.3	34.8	7.3	4.0	14.4	10.4	17.0
Dist. of Columbia	177.6	141.4	25.4	17.0	12.4	35.7	23.2	5.0	3.5	15.0	12.4	26.5
Florida	170.8	123.4	18.7	15.1	10.6	43.0	29.8	6.3	3.8	12.2	9.0	16.3
Georgia	192.1	131.5	21.1	17.7	11.9	51.0	30.0	6.5	3.8	12.7	9.5	21.5
Hawaii	152.8	108.6	16.7	13.6	9.9	35.9	22.2	6.0	3.6	12.1	9.7	14.6
Idaho	174.7	129.4	21.1	14.9	11.0	34.4	27.0	6.7	4.8	12.7	9.2	22.0
Illinois	187.8	138.1	20.9	17.3	12.2	47.2	33.1	7.1	4.1	13.4	9.8	19.7
Indiana	205.5	143.8	20.4	17.7	12.6	57.2	38.6	7.7	4.5	13.7	10.0	19.4
Iowa	190.0	133.8	18.4	16.2	11.9	48.8	33.2	7.9	4.3	12.9	9.9	20.2
Kansas	186.7	137.4	20.2	16.7	12.0	47.1	34.3	7.2	4.5	13.0	9.6	18.3
Kentucky	226.6	157.5	21.2	19.5	13.8	71.3	47.0	7.9	4.5	13.1	10.3	18.7
Louisiana	211.2	143.9	22.4	19.5	13.1	59.0	35.3	7.5	4.1	14.3	11.1	20.0
Maine	198.8	144.9	18.1	14.9	11.4	53.0	39.8	7.8	4.4	12.9	10.4	19.3
Maryland	178.9	132.6	21.0	15.8	11.6	41.5	30.6	6.6	3.6	13.1	10.0	20.3
Massachusetts	176.2	126.8	16.8	13.4	9.6	40.7	31.9	6.6	4.0	13.2	10.1	18.2
Michigan	191.6	141.7	20.4	15.9	11.5	50.0	36.4	7.8	4.6	14.0	10.8	18.4
Minnesota	173.9	127.3	17.7	14.1	10.1	38.1	29.7	7.9	4.2	12.5	9.8	19.9
Mississippi	232.2	148.9	22.8	21.9	14.4	70.1	37.3	6.8	3.7	15.3	10.7	24.7
Missouri	199.8	141.7	20.3	17.4	11.7	56.3	38.8	7.0	4.0	13.6	9.5	17.8
Montana	171.7	129.1	19.3	15.4	10.3	35.1	31.2	6.4	3.7	11.6	9.5	22.2
Nebraska	179.3	133.0	19.8	17.1	12.2	42.5	31.3	7.3	3.8	13.3	9.7	17.8
Nevada	174.6	136.4	22.0	17.8	12.9	39.8	34.3	6.5	3.8	12.0	9.2	19.0
New Hampshire	181.8	133.6	18.1	14.6	10.3	43.3	36.1	6.5	4.2	12.3	9.4	19.4
New Jersey	167.3	129.1	20.5	16.0	11.3	37.1	28.1	6.7	3.9	12.8	10.0	16.9
New Mexico	162.4	118.8	20.2	15.8	10.3	30.0	21.6	5.8	3.6	11.5	8.1	19.1
New York	164.7	124.9	18.9	14.4	10.5	38.0	27.5	6.6	3.8	12.5	9.7	17.2
North Carolina	192.6	133.3	20.5	15.5	11.0	53.5	33.3	6.8	3.7	12.7	9.5	19.7
North Dakota	172.5	124.0	18.1	17.1	9.7	41.3	28.2	6.6	3.9	12.4	9.0	18.0
Ohio	203.2	145.1	21.6	17.7	12.5	55.8	36.8	7.6	4.4	13.9	10.8	19.4
Oklahoma	214.3	150.5	22.5	20.0	13.7	60.6	39.4	7.9	4.6	12.9	9.5	20.4
Oregon	177.6	135.5	19.6	14.4	11.1	38.6	31.8	7.1	4.4	13.4	10.1	20.7
Pennsylvania	191.7	138.1	20.8	16.8	12.0	47.9	32.7	7.5	4.4	14.1	10.4	18.5
Rhode Island	188.7	134.5	17.6	13.9	10.6	46.9	35.3	6.6	3.9	14.9	9.9	18.2
South Carolina	198.2	134.3	21.2	16.9	11.1	53.2	31.5	6.2	4.0	13.3	10.0	21.0
South Dakota	184.9	132.3	18.8	17.5	12.6	44.5	33.7	7.6	4.0	12.4	10.2	19.1
Tennessee	212.5	145.4	21.8	18.1	12.5	62.7	38.6	7.6	4.5	12.8	9.6	19.6
Texas	176.4	124.1	19.9	17.2	11.1	40.7	26.0	6.6	3.9	11.8	9.0	17.7
Utah	142.8	105.1	19.8	12.2	9.7	21.0	14.3	6.7	3.6	10.9	7.9	21.1
Vermont	187.9	137.2	17.6	15.9	13.2	43.7	33.8	7.3	4.4	12.4	9.8	19.6
Virginia	183.1	130.1	20.9	16.1	11.2	46.4	29.9	6.6	3.9	12.9	9.5	19.7
Washington	174.1	130.9	19.5	14.3	10.3	38.2	30.5	7.1	4.2	12.3	9.4	20.2
West Virginia	213.8	154.3	21.6	19.9	14.4	64.1	41.7	7.9	4.5	12.3	9.8	16.8
Wisconsin	184.6	133.0	18.5	14.8	10.5	43.4	32.0	7.6	4.3	13.4	9.9	20.8
Wyoming	160.2	121.7	18.9	13.5	11.0	33.7	27.8	6.0	4.3	12.8	8.3	17.2
Puerto Rico*	134.4	87.7	17.3	17.8	11.0	15.4	7.4	4.5	2.6	8.0	5.4	22.0
United States	**181.4**	**131.1**	**19.9**	**16.0**	**11.3**	**44.5**	**30.7**	**6.9**	**4.0**	**12.7**	**9.6**	**18.9**

Rates are per 100,000, age adjusted to the 2000 US standard population. *Rates for Puerto Rico are not included in overall US combined rates.

Source: US Mortality Data, National Center for Health Statistics, Centers for Disease Control and Prevention, 2021.

do not reflect the most recent advances in detection and treatment because they are based on people who were diagnosed several years in the past (i.e., 2011-2017 for 5-year survival rates presented in this report). Second, they do not account for many factors that influence an individual's survival, including the social determinants of health, such as access to safe housing, healthy food, and treatment, as well as biological or behavioral differences. Third, improvements in survival rates over time do not always indicate progress against cancer. For example, earlier diagnosis through screening increases average survival rates, but does not always result in extended life. In other words, a person may live longer with a cancer diagnosis because screening detected the disease before symptoms arose, but their overall life span remains unchanged (lead-time bias). Survival rates also become artificially elevated when screening detects cancers that would never have caused harm if left undetected (overdiagnosis). For more information about the limitations of survival rates and how they were calculated for this report, see Sources of Statistics on page 74.

How Is Cancer Staged?

Stage describes the extent or spread of cancer and is assigned at the time of diagnosis, but also sometimes after treatment has begun. Proper staging is essential for optimizing therapy and assessing prognosis. For most cancers, stage is based on the size or extent of the primary tumor and whether the cancer has spread to nearby lymph nodes or other areas of the body. Several staging systems are used to classify cancer. This report uses a system of summary staging that is standard for descriptive and statistical analyses of population-based tumor registry data and is particularly useful for tracking trends over time. According to this system, if cancer is confined to the layer of cells where it began growing and has 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.) Not all cancers can be staged using this system, so stage distribution data for all cancers combined is unavailable.

Another staging system that is used more often by clinicians is called TNM (tumor size, nodes involved, and presence of metastasis). TNM similarly assesses cancer growth and spread and assigns a stage from 0 (in situ) for the earliest stage up to I, II, III, or IV for more advanced disease. However, some cancers do not have a stage IV (e.g., testis) and others (e.g., lymphoma) have alternative staging systems. As the biology of cancer has become better understood, additional tumor-specific features have been incorporated into staging for some cancers. For more information on cancer staging, see https://www.cancer.org/treatment/understanding-your-diagnosis/staging.html.

What Are the Costs of Cancer?

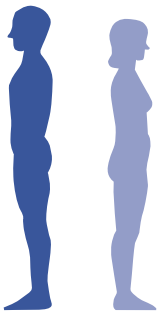
The costs of cancer are estimated in several ways, including direct medical costs (total of all health care expenditures), as well as indirect costs (such as lost earnings due to missed work from illness or premature death). The National Cancer Institute estimates that cancer-related direct medical costs in the US were $183 billion in 2015 and are projected to increase to $246 billion by 2030, a 34% increase based only on population growth and aging. However, the projection is likely an underestimate because of the growing cost of treatment; for example, the list price for many prescription medicines is now more than $100,000 annually.

Lack of health insurance coverage is strongly associated with medical financial hardship and also prevents many people from receiving optimal cancer prevention, early detection, and treatment. Despite gains in health insurance coverage following the implementation of the Affordable Care Act (ACA), about 30 million Americans ages 18 to 64 years were uninsured during the first half of 2020, according to estimates from the National Health Interview Survey. However, this number is an underestimate because of challenges in data collection as a result of the COVID-19 pandemic. In addition, it does not reflect the number of working-age people under 65 years of age who lost employer-provided health insurance as a result of the pandemic. Early estimates comparing the first months of 2020 with 2021 have shown that the proportion of people with private health insurance declined by about 1%, largely as a result of pandemic-related unemployment,

Figure 3. Leading Sites of New Cancer Cases and Deaths – 2022 Estimates

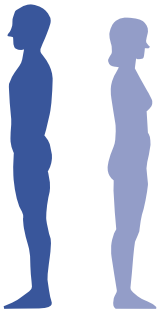
Estimated New Cases

Male			Female		
Prostate	268,490	27%	Breast	287,850	31%
Lung & bronchus	117,910	12%	Lung & bronchus	118,830	13%
Colon & rectum	80,690	8%	Colon & rectum	70,340	8%
Urinary bladder	61,700	6%	Uterine corpus	65,950	7%
Melanoma of the skin	57,180	6%	Melanoma of the skin	42,600	5%
Kidney & renal pelvis	50,290	5%	Non-Hodgkin lymphoma	36,350	4%
Non-Hodgkin lymphoma	44,120	4%	Thyroid	31,940	3%
Oral cavity & pharynx	38,700	4%	Pancreas	29,240	3%
Leukemia	35,810	4%	Kidney & renal pelvis	28,710	3%
Pancreas	32,970	3%	Leukemia	24,840	3%
All sites	**983,160**		**All sites**	**934,870**	



Estimated Deaths

Male			Female		
Lung & bronchus	68,820	21%	Lung & bronchus	61,360	21%
Prostate	34,500	11%	Breast	43,250	15%
Colon & rectum	28,400	9%	Colon & rectum	24,180	8%
Pancreas	25,970	8%	Pancreas	23,860	8%
Liver & intrahepatic bile duct	20,420	6%	Ovary	12,810	4%
Leukemia	14,020	4%	Uterine corpus	12,550	4%
Esophagus	13,250	4%	Liver & intrahepatic bile duct	10,100	4%
Urinary bladder	12,120	4%	Leukemia	9,980	3%
Non-Hodgkin lymphoma	11,700	4%	Non-Hodgkin lymphoma	8,550	3%
Brain & other nervous system	10,710	3%	Brain & other nervous system	7,570	3%
All sites	**322,090**		**All sites**	**287,270**	



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

while the proportion of people with public health insurance (e.g., Medicaid) increased. Uninsured individuals and those from other marginalized populations are substantially more likely to be diagnosed with cancer at a later stage, when treatment is often more involved, costlier, and less successful. To learn more about how the ACA helps save lives from cancer, see the Advocacy section on page 68.

Importantly, medical financial hardship and lost income due to cancer diagnosis, treatment, and recovery are not limited to those without health insurance. Many insured cancer patients, especially those who are younger and/or low-income, report difficulty paying medical bills, anxiety about the cost of treatment, and delayed or forgone medical care due to cost.

Selected Cancers

This section provides information on the occurrence, risk factors, symptoms, early detection, and treatment for the most commonly diagnosed cancers, and may have limited relevance for specific cancer subtypes. (For information on rare cancers, see the Special Section in *Cancer Facts & Figures 2017* at cancer.org/statistics.) Cancer trends are generally based on incidence data from 2000 through 2018 from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program, and mortality data from 1975 through 2019 from the National Center for Health Statistics. See Sources of Statistics on page 74 for more information.

Breast

New cases and deaths: In the US in 2022, invasive breast cancer will be newly diagnosed in an estimated 287,850 women and 2,710 men, with an additional 51,400 cases of

ductal carcinoma in situ (DCIS) diagnosed in women (Table 1; Figure 3). An estimated 43,780 breast cancer deaths (43,250 in women, 530 in men) will occur in 2022.

Incidence trends: Invasive female breast cancer incidence rates have been increasing by about 0.5% per year since the mid-2000s.

Mortality trends: The breast cancer death rate among females peaked in 1989, and has since declined by 42% as of 2019, mainly because of earlier detection through screening, as well as increased breast cancer awareness and improved treatment. This decrease translates to approximately 431,800 fewer breast cancer deaths during this time period than would have been expected in the absence of this progress. However, mortality in Black women remains 41% higher than in White women, despite lower incidence.

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

Prevention: Some women at high risk because of a strong family history or inherited genetic mutations may consider preventive surgery (prophylactic mastectomy) to remove the breasts, which greatly reduces the risk of breast cancer.

Early detection: Early diagnosis reduces the risk of death from breast cancer and increases treatment options. Mammography is a low-dose x-ray procedure used to detect breast cancer before it becomes symptomatic. However, like any screening tool, mammography is not perfect. It can sometimes miss cancer (a false-negative result) or appear abnormal in the absence of cancer (a false-positive result); about 12% of women who are screened have abnormal results that require further testing, but only 4% of women with an abnormal mammogram have cancer. Follow-up testing may cause anxiety and additional costs (e.g., medical, transportation). Other potential harms of screening include detection and treatment of breast cancers and in situ lesions (e.g., DCIS) that would never have progressed or caused harm (i.e., overdiagnosis and overtreatment). Although radiation exposure from mammograms is cumulative over time, it does not meaningfully increase breast cancer risk.

Women are encouraged to devise an individualized screening plan with their health care team based on personal preferences, family history, and a risk assessment. For women at average risk of developing breast cancer, the American Cancer Society recommends that those ages 45 to 54 years undergo annual mammography; those 55 and older either transition to biennial mammography or continue annual exams; and those 40 to 44 years of age have the option to begin annual mammography. In general, mammographic screening should continue while overall health is good and life expectancy is 10 or more years. For some women at high risk, annual breast magnetic resonance imaging (MRI) is recommended along with mammography, often starting at a younger age than the general population. For more information on breast cancer screening, see the American Cancer Society's screening guidelines on page 77.

Signs and symptoms: The most common signs/symptoms of breast cancer are a lump or mass in the breast; persistent changes to the breast, including skin

thickening, breast swelling, or skin redness, and nipple abnormalities such as spontaneous discharge (especially if bloody), scaliness, or retraction (drawing back within itself). Early-stage breast cancer often causes no signs or symptoms, which is why screening is important.

Treatment: There are two general aspects of treatment for early-stage breast cancer – local therapy (surgical and radiation treatments to the breast, nearby lymph nodes, and chest) and systemic therapy (e.g., chemotherapy). Treatment to the breast usually involves either breast-conserving surgery (surgical removal of the tumor and a rim of surrounding normal tissue) with radiation or mastectomy (surgical removal of the entire breast). One or more underarm lymph nodes are usually evaluated to determine whether the tumor has spread beyond the breast. For early-stage breast cancer (no spread to the skin, chest wall, or distant organs), breast-conserving surgery plus radiation therapy results in long-term survival that is equivalent to mastectomy. Although most patients undergoing mastectomy do not need radiation, it is sometimes recommended for larger tumors or lymph node involvement. Women undergoing mastectomy who elect breast reconstruction have several options, including the type of tissue or implant used to restore breast shape. Reconstruction may be performed at the time of mastectomy (immediate reconstruction) or later as a second procedure (delayed reconstruction), but it often requires more than one surgery. Depending on cancer stage, subtype, and sometimes other test results, such as tumor gene expression profiling (e.g., Oncotype DX), treatment may also involve chemotherapy (before and/or after surgery), hormone (anti-estrogen) therapy, targeted therapy, and/or immunotherapy (e.g., checkpoint inhibitors).

Survival: The 5- and 10-year relative survival rates are 90% and 84%, respectively, for invasive breast cancer, partly because almost two-thirds of women (65%) are diagnosed with localized-stage disease. Although survival has improved over time, large inequalities remain, especially for Black women. For example, the survival rate is 10% lower (in absolute terms) for Black women (82%) than for White women (92%; Table 7).

Reducing this and other disparities is a focus of the American Cancer Society and many other national cancer organizations.

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

Cancer in Children and Adolescents

New cases and deaths: In 2022, an estimated 10,470 children (ages 0 to 14 years) and 5,480 adolescents (ages 15-19 years) will be diagnosed with cancer and 1,050 children and 550 adolescents will die from the disease. Cancer is the second-leading cause of death among children ages 1-14 years, after accidents. The most commonly diagnosed cancers in children and adolescents are leukemia (28% and 13%, respectively); brain, including benign and borderline malignant tumors (26% and 21%); and lymphoma (12% and 19%).

Incidence trends: Overall, incidence rates have increased since 1975 by 0.8% per year on average among both children and adolescents, although trends vary by cancer type.

Mortality trends: The death rate for cancer has declined by more than half from 1970 to 2019 in both children (from 6.3 per 100,000 to 1.8) and adolescents (from 7.2 to 2.8), largely due to improvements in treatment and high participation in clinical trials, especially among children.

Risk factors: There are few known risk factors for cancer that occurs during childhood or adolescence, and most cases are thought to be due to random cell mutations without an external cause. Exposure to ionizing radiation, such as that from prior radiation therapy, increases the risk of leukemia, brain tumors, and possibly other neoplasms. Solid organ transplant recipients are at increased risk for non-Hodgkin lymphoma, largely due to drugs that suppress the immune system to prevent organ rejection. Infection with Epstein-Barr virus (EBV) is associated with some types of non-Hodgkin lymphoma, such as Burkitt lymphoma. Cancer risk is also increased in children and adolescents with certain genetic syndromes (e.g., Down syndrome, Li-Fraumeni syndrome, and Beckwith-Wiedemann syndrome).

Signs and symptoms: Many early signs and symptoms of childhood and adolescent cancer include nonspecific symptoms shared by common childhood conditions, which can challenge timely diagnosis. Parents or other caregivers should ensure 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; persistent, localized pain or limping; 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):

- Leukemia may cause bone and joint pain, fatigue, weakness, pale skin, bleeding or bruising easily, fever, or infection.
- Brain and other central nervous system tumors may cause headaches, nausea, vomiting, blurred or double vision, seizures, dizziness, and difficulty walking or handling objects.
- Lymphoma often causes lymph nodes to swell, which can appear as a lump in the neck, armpit, or groin; other symptoms can include fatigue, swelling or pain in the abdomen, weight loss, and fever.
- Neuroblastoma, a cancer of the peripheral nervous system that is most common in children under 5 years of age, usually appears as a swelling in the abdomen, sometimes accompanied by loss of appetite.
- Wilms tumor, also called nephroblastoma, is a kidney cancer that may appear as swelling or a lump in the abdomen, sometimes with blood in the urine.
- Rhabdomyosarcoma is a soft tissue sarcoma that occurs in muscle tissue, most often in the head or neck, genitourinary area, or extremities, and may cause pain and/or a mass or swelling at the tumor site.
- Retinoblastoma, an eye cancer that usually occurs in children under 5 years of age, may cause vision problems and is often recognized because the pupil appears white or pink instead of the normal red color in flash photographs or during an eye examination.
- Osteosarcoma, 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, another cancer usually arising in the bone in adolescents, typically appears as pain or swelling at the tumor site.
- Gonadal germ cell tumors occur in the ovaries in girls and can be difficult to detect because symptoms, such as abdominal pain, often do not present until the tumor is advanced; in boys, these tumors are in the testes, and are often visible and may cause pain at an early stage.

Treatment: Treatment is based on type and stage of cancer and is typically coordinated by a team of experts, including pediatric oncologists and nurses, social workers, psychologists, and others trained to assist young patients and their families. Outcomes are generally most successful when treatment is managed by specialists at a children's cancer center. Adolescents may be treated in the pediatric or adult oncology setting depending on cancer type and preference, although superior outcomes in the pediatric setting have been reported for some cancers (e.g., acute lymphocytic leukemia). If the child or adolescent is eligible, placement in a clinical trial, which usually compares a new treatment with the best available standard treatment, should be considered.

Survival: Excluding benign and borderline brain tumors, the 5-year relative survival rate during 2011 to 2017 for all cancers combined classified by the ICCC was 85% among children and 86% among adolescents, although rates vary considerably depending on cancer type, patient age, and other factors. The overall survival rate among adolescents is heavily influenced by high survival for thyroid cancer (>99%) and Hodgkin lymphoma (97%), masking lower survival than children for several cancers, including acute lymphocytic leukemia (76% versus 92%) and Ewing sarcoma (59% versus 76%). (For more childhood and adolescent cancer survival rates, see the Cancer Statistics Center). Some treatment-related side effects may persist, or even begin, long after treatment ends, including impaired organ function (e.g., memory problems) and new cancers at the same or different sites. The Children's

Table 6. Probability (%) of Developing Invasive Cancer During Selected Age Intervals by Sex, US, 2016-2018*

Site	Sex	0 to 49	50 to 59	60 to 69	70 and older	Birth to death
All sites†	Male	3.4 (1 in 29)	6.2 (1 in 16)	13.6 (1 in 7)	32.9 (1 in 3)	40.2 (1 in 2)
	Female	5.8 (1 in 17)	6.3 (1 in 16)	10.2 (1 in 10)	26.5 (1 in 4)	38.5 (1 in 3)
Breast	Female	2.1 (1 in 48)	2.4 (1 in 41)	3.5 (1 in 28)	7.0 (1 in 14)	12.9 (1 in 8)
Colon & rectum	Male	0.4 (1 in 249)	0.7 (1 in 143)	1.1 (1 in 94)	3.1 (1 in 32)	4.2 (1 in 24)
	Female	0.4 (1 in 265)	0.5 (1 in 192)	0.8 (1 in 130)	2.9 (1 in 35)	4.0 (1 in 25)
Kidney & renal pelvis	Male	0.2 (1 in 413)	0.4 (1 in 259)	0.7 (1 in 151)	1.4 (1 in 73)	2.2 (1 in 46)
	Female	0.2 (1 in 645)	0.2 (1 in 532)	0.3 (1 in 311)	0.8 (1 in 133)	1.3 (1 in 79)
Leukemia	Male	0.3 (1 in 386)	0.2 (1 in 531)	0.4 (1 in 254)	1.5 (1 in 68)	1.9 (1 in 54)
	Female	0.2 (1 in 498)	0.1 (1 in 823)	0.2 (1 in 421)	0.9 (1 in 110)	1.3 (1 in 77)
Lung & bronchus	Male	0.1 (1 in 812)	0.6 (1 in 169)	1.7 (1 in 59)	5.7 (1 in 17)	6.4 (1 in 16)
	Female	0.1 (1 in 690)	0.6 (1 in 175)	1.4 (1 in 71)	4.8 (1 in 21)	6.0 (1 in 17)
Melanoma of the skin‡	Male	0.4 (1 in 233)	0.5 (1 in 198)	0.9 (1 in 109)	2.7 (1 in 37)	3.7 (1 in 27)
	Female	0.6 (1 in 157)	0.4 (1 in 241)	0.5 (1 in 184)	1.2 (1 in 84)	2.5 (1 in 40)
Non-Hodgkin lymphoma	Male	0.3 (1 in 377)	0.3 (1 in 343)	0.6 (1 in 178)	1.8 (1 in 54)	2.4 (1 in 42)
	Female	0.2 (1 in 515)	0.2 (1 in 453)	0.4 (1 in 245)	1.4 (1 in 73)	1.9 (1 in 52)
Prostate	Male	0.2 (1 in 456)	1.8 (1 in 54)	5.1 (1 in 19)	9.0 (1 in 11)	12.5 (1 in 8)
Thyroid	Male	0.2 (1 in 453)	0.1 (1 in 732)	0.2 (1 in 581)	0.2 (1 in 423)	0.7 (1 in 149)
	Female	0.9 (1 in 117)	0.4 (1 in 271)	0.3 (1 in 294)	0.4 (1 in 264)	1.8 (1 in 55)
Uterine cervix	Female	0.3 (1 in 359)	0.1 (1 in 839)	0.1 (1 in 944)	0.2 (1 in 594)	0.6 (1 in 159)
Uterine corpus	Female	0.3 (1 in 320)	0.6 (1 in 157)	1.1 (1 in 94)	1.5 (1 in 66)	3.1 (1 in 32)

*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 6.7.9. Statistical Research and Applications Branch, National Cancer Institute, 2021. surveillance.cancer.gov/devcan/.

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

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.

For more information on cancer in children and adolescents, see the *Cancer Facts & Figures 2014* Special Section: Cancer in Children & Adolescents and *Cancer Facts & Figures 2020* Special Section: Cancer in Adolescents & Young Adults at cancer.org/statistics, as well as the Childhood Cancer Research Landscape Report at cancer.org.

Colon and Rectum

New cases and deaths: In 2022, an estimated 106,180 cases of colon cancer and 44,850 cases of rectal cancer will be diagnosed in the US, and a total of 52,580 people will die from these cancers (Table 1). Unfortunately, accurate statistics on deaths from colon versus rectal cancers are not available because many deaths from rectal cancer are misclassified as colon cancer on death certificates. The misclassification is largely attributed to historically widespread use of "colon cancer" to refer to colon and rectal cancer in educational messaging because of cultural reluctance to use the term rectum.

Incidence trends: Colorectal cancer (excluding appendiceal tumors) incidence has generally declined since the mid-1980s, with accelerated progress shortly after widespread uptake of screening during the 2000s among adults ages 50 and older. From 2014 to 2018, incidence rates decreased by about 2% per year in adults 50 and older, but increased by 1.5% per year in younger individuals, a trend that began in the mid-1990s for unknown reasons.

Mortality trends: The colorectal cancer death rate has dropped by 56%, from 29.2 (per 100,000) in 1970 to 12.8 in 2019, mostly due to earlier detection through screening and improvements in treatment; from 2015 to 2019, the death rate declined by about 2% per year. Similar to incidence, however, this progress contrasts with rising

mortality in adults under 55 years of age since the mid-2000s.

Risk factors: More than half (55%) of colorectal cancers in the US are attributable to potentially modifiable risk factors, including excess body weight, physical inactivity, long-term smoking, high consumption of red or processed meat, low calcium intake, heavy alcohol consumption, and very low intake of fruits and vegetables and whole-grain fiber. Hereditary/genetic and medical factors that increase risk include a personal or family history of colorectal cancer or adenomatous polyps, certain inherited genetic syndromes (e.g., Lynch syndrome), a personal history of chronic inflammatory bowel disease (ulcerative colitis or Crohn's disease), and type 2 diabetes. Regular long-term use of nonsteroidal anti-inflammatory drugs, such as aspirin, reduces risk, but can have serious adverse health effects such as gastrointestinal bleeding. Decision-making about aspirin use for cancer risk reduction should involve a conversation with your health care provider.

Prevention and early detection: Screening can prevent colorectal cancer through the detection and removal of precancerous growths (polyps), as well as detect cancer at an early stage, when treatment is usually less intensive and more successful. Regular adherence to screening with either stool testing (fecal immunochemical tests, highly sensitive guaiac-based tests, or a multi-target stool DNA test) or structural exams (e.g., colonoscopy or computed tomography colonography) results in a similar reduction in premature colorectal cancer death over a lifetime. The American Cancer Society and the US Preventive Services Task Force recommend that individuals at average risk for colorectal cancer begin screening at age 45 years and continue through age 75, with more individualized decision-making from ages 76 to 85 based on health status, life expectancy, patient preferences, and prior screening history. For more information on colorectal cancer screening, see the American Cancer Society's screening guidelines on page 77.

Signs and symptoms: The most common signs and symptoms are rectal bleeding, blood in the stool, changes in bowel habits (e.g., constipation or diarrhea) 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 is not noticeable but results in anemia (low red blood cell count) that may be detected on a blood test and/or symptoms such as weakness, fatigue, or shortness of breath. Increasing incidence of colorectal cancer in young individuals, who are often diagnosed with advanced disease, reinforces the need for timely evaluation of persistent symptoms in patients of all ages. Early-stage colorectal cancer typically does not cause symptoms, which is why screening according to patient risk is so important.

Treatment: Surgery is the most common treatment for colorectal cancer that has not spread to distant sites. 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. When cancer has penetrated the bowel wall deeply or spread to lymph nodes, colon cancer patients typically receive chemotherapy after surgery, whereas rectal cancer patients may receive chemotherapy before and/or after surgery, alone or in combination with radiation. 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 that can be highly effective for some advanced cancers.

Survival: The 5-year relative survival rate for colorectal cancer is 65% overall, but ranges from 91% to 72% for patients diagnosed with localized- and regional-stage disease, respectively, down to 15% for distant-stage disease (Table 8).

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

Kidney and Renal Pelvis

New cases and deaths: In 2022, an estimated 79,000 new cases of kidney (renal) cancer will be diagnosed in the US and 13,920 people will die from the disease (Table 1). Most kidney cancers are renal cell carcinomas; other types include cancer of the renal pelvis (5%), which behaves more like bladder cancer, and Wilms tumor (1%), a

childhood cancer that usually develops before the age of 5 (see Cancer in Children and Adolescents on page 12). Men are twice as likely as women to be diagnosed with kidney cancer.

Incidence trends: The long-term increase in kidney cancer incidence, largely for localized-stage diagnoses, is partly attributed to incidental detection of asymptomatic tumors through increased medical imaging. From 2009 to 2018, the incidence rate increased by about 1% per year.

Mortality trends: In contrast to incidence trends, kidney cancer mortality has been declining since the mid-1990s, with the pace accelerating in recent years; from 2015 to 2019, the rate decreased by 2.5% per year.

Risk factors: About half of kidney cancers could potentially be prevented by eliminating strong risk factors like excess body weight and tobacco smoking. Risk is also increased by chronic high blood pressure; chronic renal failure; and occupational exposure to certain chemicals, such as trichloroethylene. A small proportion of kidney cancers are the result of rare hereditary conditions (e.g., von Hippel-Lindau disease). Moderate alcohol consumption (up to about 2 drinks per day) is associated with a reduced risk of renal cell carcinoma, although increased risk of other diseases, including several cancers, far outweighs this benefit.

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

Treatment: Surgery is the primary treatment for most kidney cancers, although active surveillance (observation) may be an option for some patients with small tumors. Patients who are not surgical candidates may be offered ablation therapy, a procedure that uses extreme heat or cold to destroy the tumor. Adjuvant treatment (after surgery) with a targeted therapy drug may be an option for certain patients at high risk for cancer recurrence. For metastatic disease, immunotherapy and targeted therapies are the main treatment options, sometimes along with removal of the kidney.

Survival: The 5-year relative survival rate for kidney and renal pelvis cancer is 76% (Table 8), largely because two-thirds of cases are diagnosed at a local stage.

Leukemia

New cases and deaths: In 2022, an estimated 60,650 new cases of leukemia will be diagnosed in the US and 24,000 people will die from the disease (Table 1). Leukemia is a cancer of the bone marrow and blood that is classified into four main groups based on cell type and rate of growth: acute lymphocytic leukemia (ALL), acute myeloid leukemia (AML), chronic myeloid leukemia (CML), and chronic lymphocytic leukemia (CLL). Although CLL is included with leukemia in this report to enable description of trends over time, it is now recognized to be the same disease as small lymphocytic lymphoma (SLL). These cancers are collectively referred to as CLL/SLL and classified as a type of non-Hodgkin lymphoma. The most common types of leukemia among adults (20 years of age and older) are CLL (38%) and AML (31%) and among children and adolescents (ages 0 to 19 years) are ALL (75%) and AML (17%). (See page 12 for information about cancer in children and adolescents.)

Incidence trends: From 2009 to 2018, the leukemia incidence rate increased in children and adolescents by about 1% per year and was stable in adults ages 20 and older, although trends varied by subtype.

Mortality trends: In contrast to incidence, the leukemia death rate declined from 2010 to 2019 by about 2% per year in adults, double the pace of the decline during the 2000s, and by 3% per year in children and adolescents.

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

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

Treatment: Chemotherapy, sometimes in combination with targeted drugs, is used to treat most acute leukemias. Several targeted drugs are effective for treating CML because they attack cells with the Philadelphia chromosome, the acquired genetic abnormality that is the hallmark of the disease. Some of these drugs are also used to treat a type of ALL with a similar genetic defect. CLL that is not progressing or causing symptoms may not require treatment right away, but these patients need to be closely monitored. More aggressive CLL is treated with targeted drugs and/or chemotherapy. Certain types of leukemia may be treated with high-dose chemotherapy followed by stem cell transplantation under appropriate conditions. Newer treatments that boost the body's immune system, such as CAR T-cell therapy, have shown much promise, even against some hard-to-treat leukemias.

Survival: Five-year relative survival rates vary substantially by age and leukemia subtype: the rate is 27% for AML, 40% for ALL, 70% for CML, and 87% for CLL among adults ages 20 and older, and 69% for AML and 89% for ALL among youth ages 0-19 years. Treatment advances such as the development of targeted drugs have resulted in large survival improvements for most types of leukemia; for example, the current 5-year relative survival rate for CML is triple that in the mid-1970s (22%).

Liver

New cases and deaths: In 2022, an estimated 41,260 new cases of liver cancer will be diagnosed in the US and 30,520 people will die from the disease (Table 1). The most common types of liver cancer are hepatocellular carcinoma (HCC; 73%) and intrahepatic bile duct cancer (cholangiocarcinoma; 18%). Liver cancer incidence is almost 3 times higher in men than in women.

Incidence trends: Liver cancer incidence more than tripled from 1980 to 2015, but appears to have stabilized in recent years.

Mortality trends: Similar to incidence, liver cancer mortality rates more than doubled from 1980 to 2013, but thereafter remained stable through 2019.

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

Prevention: A vaccine that protects against HBV infection has been available since 1982. There is no vaccine available to prevent HCV infection, although new combination antiviral therapies can often clear established infections and reduce cancer risk. The Centers for Disease Control and Prevention (CDC) and US Preventive Services Task Force recommend one-time HCV testing of adults 18 years of age and older; testing of all women during every pregnancy; and regular testing of people at high risk, such as those who have ever injected drugs. 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 people who inject drugs; and safer sex. Visit the CDC website at cdc.gov/hepatitis for more information on viral hepatitis.

Early detection: Although there is no recommended screening test for liver cancer, many health care providers in the US test individuals at high risk (e.g., those with cirrhosis) with ultrasound and/or blood tests.

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

Table 7. Trends in 5-year Relative Survival Rates* (%) by Race, US, 1975-2017

	All races			White			Black		
	1975-77	1995-97	2011-17	1975-77	1995-97	2011-17	1975-77	1995-97	2011-17
All sites	49	63	68	50	64	68	39	54	63
Brain & other nervous system	23	32	33	22	31	30	25	39	40
Breast (female)	75	87	90	76	89	92	62	75	82
Colon & rectum	50	61	65	50	62	65	45	54	59
Colon	51	61	64	51	62	65	45	54	58
Rectum	48	62	67	48	62	67	44	55	64
Esophagus	5	13	20	6	14	21	4	9	14
Hodgkin lymphoma	72	84	88	72	85	89	70	82	86
Kidney & renal pelvis	50	62	76	50	62	76	49	62	76
Larynx	66	66	61	67	68	62	58	52	53
Leukemia	34	48	65	35	50	66	33	42	61
Liver & intrahepatic bile duct	3	7	20	3	7	19	2	4	17
Lung & bronchus	12	15	22	12	15	22	11	13	20
Melanoma of the skin	82	91	93	82	91	93	57†	76†	71
Myeloma	25	32	56	24	32	55	29	32	58
Non-Hodgkin lymphoma	47	56	73	47	57	74	49	49	69
Oral cavity & pharynx	53	58	67	54	60	69	36	38	51
Ovary	36	43	49	35	43	48	42	36	41
Pancreas	3	4	11	3	4	11	2	4	10
Prostate	68	97	98	69	97	98	61	94	96
Stomach	15	22	32	14	20	32	16	22	32
Testis	83	96	95	83	96	96	73†‡	86†	92
Thyroid	92	95	98	92	96	99	90	95	97
Urinary bladder	72	80	77	73	81	78	50	63	65
Uterine cervix	69	73	66	70	74	67	65	66	56
Uterine corpus	87	84	81	88	86	84	60	62	63

*Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 9 areas for 1975 to 1977 and 1995 to 1997, and in SEER 18 areas for 2011-2017; all cases were followed through 2018. Rates for White and Black patients diagnosed during 2011-2017 are exclusive of Hispanic ethnicity. †The standard error is between 5 and 10 percentage points. ‡Survival rate is for cases diagnosed from 1978 to 1980.

Sources: 2011-2017 survival – SEER*Explorer, National Cancer Institute, 2021. Available from https://seer.cancer.gov/explorer/. Other survival statistics were calculated using SEER*Stat software (version 8.3.9), National Cancer Institute, 2021.

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

Survival: The 5-year relative survival rate for liver cancer is 20%, up from 3% four decades ago. Even for the 43% of patients diagnosed with localized-stage disease, 5-year survival is only 35% (Table 8).

Lung and Bronchus

New cases and deaths: In 2022, an estimated 236,740 new cases of lung cancer will be diagnosed in the US and 130,180 people will die from the disease (Table 1). Most lung cancers are classified as either non-small cell lung cancer (NSCLC; 82%) or small cell lung cancer (SCLC; 14%).

Incidence trends: Lung cancer incidence 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 2009 to 2018, the rate decreased by 2.8% per year in men and by 1.4% per year in women.

Mortality trends: Lung cancer mortality rates have declined by 56% since 1990 in men and by 32% since 2002 in women largely due to reductions in smoking, with the pace accelerating in recent years due to major advances in treatment for NSCLC; from 2015 to 2019, the rate decreased by about 5% per year in men and 4% per year in women.

Risk factors: Cigarette smoking is by far the most important risk factor for lung cancer, with approximately 80% of lung cancer deaths in the US still caused by smoking. Risk increases with both quantity and duration of smoking. Cigar and pipe smoking also increase risk. (See the Tobacco section, page 52 for more information.) Exposure to radon gas, which is released from soil and can accumulate in indoor air, is the second-leading cause of lung cancer in the US. Other factors associated with increased risk include exposure to secondhand smoke (2.7% of new cases, the equivalent of about 6,400 in 2022), asbestos (particularly among people who smoke), certain metals (chromium, cadmium, arsenic), some organic chemicals, radiation, air pollution, and diesel exhaust. Specific occupational exposures that increase risk include rubber manufacturing, paving, roofing, painting, and chimney sweeping.

Early detection: Lung cancer screening with low-dose spiral computed tomography (LDCT) has been shown to reduce lung cancer mortality. The American Cancer Society (ACS) is currently reviewing recent scientific evidence in order to update our lung cancer screening guideline, which is expected to be released in 2022. In the meantime, ACS recommends following guidance from the US Preventive Services Task Force and other major organizations, which recommend annual LDCT for generally healthy adults ages 50 to 80 years with a 20 pack-year smoking history who smoke or have quit within the past 15 years.

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

Treatment: Appropriate treatment is based on whether the tumor is NSCLC or SCLC, as well as its stage and molecular characteristics. For early-stage NSCLC, surgery is the usual treatment for otherwise healthy individuals, sometimes with other treatments such as chemotherapy, targeted drugs, immunotherapy, and/or radiation therapy. Advanced-stage NSCLC is usually treated with chemotherapy, targeted drugs, and/or immunotherapy. Early-stage SCLC is usually treated with chemotherapy, alone or combined with radiation. Radiation to the brain (prophylactic cranial radiation) is sometimes given in early-stage SCLC to reduce the risk of brain metastases. People with advanced SCLC might be treated with chemotherapy with or without immunotherapy; a large percentage of patients on this regimen experience temporary remission.

Survival: The 5-year relative survival rate for lung cancer is 22% overall (18% for men and 25% for women); 26% for NSCLC; and 7% for SCLC. Only 24% of lung cancers are diagnosed at a localized stage, for which the 5-year survival rate is 60% (Table 8).

Lymphoma

New cases and deaths: In 2022, an estimated 89,010 new cases of lymphoma will be diagnosed in the US and 21,170 people will die from the disease (Table 1). This cancer begins in immune system cells and can occur almost anywhere in the body. Lymphomas are broadly grouped as Hodgkin lymphoma (8,540 cases and 920 deaths in 2022) or non-Hodgkin lymphoma (NHL, 80,470 cases and 20,250 deaths) and are further classified based on cell composition and characteristics such as cell-surface markers and anatomic site. (Although chronic lymphocytic leukemia is now classified as a type of NHL, statistics for NHL herein exclude these cancers for the purpose of describing historical trends.)

Incidence trends: From 2009 to 2018, incidence rates continued a steady decline of 1.4% per year for Hodgkin lymphoma, but also declined by 0.4% per year for NHL after decades of increase.

Mortality trends: The death rate has been declining since at least 1975 for Hodgkin lymphoma and since 1997 for NHL due to improvements in treatment and reductions in incidence and improved survival for human immunodeficiency virus (HIV)-associated NHL. From

2010 to 2019, the death rate decreased by 4.5% per year for Hodgkin lymphoma and 2.2% per year for NHL.

Risk factors: Typical of most cancers, the overall risk of NHL increases with age. In contrast, Hodgkin lymphoma incidence peaks first during adolescence/early adulthood and then again in later life. Most known risk factors for lymphoma are associated with severely altered immune function. For example, risk is elevated in people who receive immune suppressants to prevent organ transplant rejection and those who have certain autoimmune disorders (e.g., Sjögren syndrome, lupus, and rheumatoid arthritis). Certain infectious agents (e.g., Epstein-Barr virus) increase the risk of some lymphoma subtypes directly, whereas others increase risk indirectly by weakening the immune system (e.g., HIV) or continuously activating it (e.g., *Helicobacter pylori* and hepatitis C virus). Excess body weight and certain environmental exposures may also increase risk for some lymphoma subtypes.

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

Treatment: NHL patients are usually treated with chemotherapy, although targeted drugs, immunotherapy, and/or radiation might also be part of treatment for some NHL subtypes. If NHL persists or recurs after standard treatment, stem cell transplantation may be an option. Newer therapies that help the body's immune system recognize and attack lymphoma cells (e.g., CAR T-cell therapy) have shown promising results for some hard-to-treat or recurrent lymphomas.

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

Survival: Survival varies widely by lymphoma subtype, stage of disease, and age at diagnosis; overall 5-year relative survival is 88% for Hodgkin lymphoma and 73% for NHL.

Oral Cavity and Pharynx

New cases and deaths: In 2022, an estimated 54,000 new cases of cancer of the oral cavity and pharynx (throat) will be diagnosed in the US and 11,230 people will die from the disease (Table 1). Incidence rates are more than twice as high in men as in women.

Incidence trends: Incidence rates increased by 0.8% per year from 2009 to 2018, mostly confined to non-Hispanic White persons and a subset of cancers in the oropharynx (part of the throat behind the oral cavity that includes the back one-third of the tongue, soft palate, and tonsils) associated with human papillomavirus (HPV) infection.

Mortality trends: Mirroring incidence, the mortality rate for cancers of the oral cavity and pharynx increased slightly in recent years (by 0.4% per year from 2010 to 2019) after decades of decline because of an uptick in deaths from cancer subsites associated with HPV.

Risk factors: Known risk factors include any form of tobacco use and alcohol consumption, with 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: The FDA recently added oral cancer prevention as an indication for the HPV vaccine, originally introduced for cervical cancer prevention (see page 27). Unfortunately, immunization rates are much lower than for other vaccines, with only 59% of adolescents ages 13 to 17 years (56% of boys and 61% of girls) up to date with HPV vaccination in 2020.

Signs and symptoms: Symptoms may include a sore 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

Table 8. Five-year Relative Survival Rates* (%) by Stage at Diagnosis, US, 2011-2017

	All stages	Local	Regional	Distant		All stages	Local	Regional	Distant
Breast (female)	90	99	86	29	Oral cavity & pharynx	67	85	68	40
Colon & rectum	65	91	72	15	Ovary	49	93	75	30
Colon	64	91	72	14	Pancreas	11	42	14	3
Rectum	67	90	73	17	Prostate	98	>99	>99	31
Esophagus	20	46	26	5	Stomach	32	70	32	6
Kidney†	76	93	71	14	Testis	95	99	96	73
Larynx	61	78	46	34	Thyroid	98	>99	98	53
Liver‡	20	35	12	3	Urinary bladder§	77	70	38	6
Lung & bronchus	22	60	33	6	Uterine cervix	66	92	58	18
Melanoma of the skin	93	99	68	30	Uterine corpus	81	95	69	18

*Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 18 areas from 2011-2017, all followed through 2018. Rates by stage reflect Combined Summary Stage 2004+ except for testicular cancer, which is based on Combined Summary Stage 2000 (2004-2017). †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.

Sources: SEER*Explorer, National Cancer Institute, 2021. Available from https://seer.cancer.gov/explorer/. Testicular cancer survival by stage was calculated using SEER*Stat software (version 8.3.9), National Cancer Institute, 2021.

blood. Difficulty chewing, swallowing, or moving the tongue or jaw are often late symptoms.

Treatment: Surgery and/or radiation therapy are standard treatments; chemotherapy is often added for high-risk or advanced disease. Chemotherapy or targeted therapy may be combined with radiation as initial treatment in some cases. Immunotherapy with or without chemotherapy is a newer option for advanced or recurrent cancer.

Survival: The 5-year relative survival rate for cancers of the oral cavity and pharynx overall is 67% (Table 8) but is much lower in Black people (51%) than in White people (69%) (Table 7). This partly reflects the higher proportion in Whites of HPV-associated cancer, which generally has better outcomes.

Ovary

New cases and deaths: In 2022, an estimated 19,880 new cases of ovarian cancer will be diagnosed in the US and 12,810 women will die from the disease (Table 1). About 90% of cases are epithelial ovarian cancer, the majority of which are high-grade serous tumors, which have the fewest established risk factors and worst prognosis.

Incidence trends: The ovarian cancer incidence rate declined by 1% to 2% per year from 1990 to the mid-2010s but accelerated to about 3% per year from 2014 to 2018. Although reasons for the favorable trends are not fully understood, increased oral contraceptive use in the latter half of the past century and decreased menopausal hormone therapy use during the 2000s likely contributed.

Mortality trends: Similar to incidence, the pace of the decline in ovarian cancer mortality has accelerated from 2% annually during the 2000s and early 2010s to 3% annually from 2015 to 2019, likely reflecting decreased incidence and improved treatment.

Risk factors: The most important risk factor other than age is a strong family history of breast or ovarian cancer. Women who have certain inherited mutations (e.g., *BRCA1* or *BRCA2* or those related to Lynch syndrome) are at increased risk. Other medical conditions and characteristics associated with increased risk include a personal history of breast cancer, endometriosis, or pelvic inflammatory disease, and tall adult height. Modifiable factors associated with increased risk include menopausal hormone therapy (estrogen alone or combined with progesterone), previously referred to as hormone replacement therapy or HRT, and excess body weight.

Cigarette smoking is associated with a rare subtype (mucinous). Factors associated with lower risk include pregnancy/higher number of children, later age at menarche, earlier age at menopause, fallopian tube ligation or removal (salpingectomy), and use of oral contraceptives. Accumulating evidence suggests that risk is also reduced with frequent aspirin use, although this can have serious adverse health effects, so aspirin use for cancer prevention should only occur in consultation with a health care provider. The weight of the evidence does not support an association between ovarian cancer and genital exposure to talc-based powder, although results from case-control and cohort studies are inconsistent.

Prevention: Some women at high risk because of a strong family history or inherited genetic mutations may consider preventive surgery (prophylactic bilateral salpingo-oophorectomy) to remove both ovaries and fallopian tubes, which greatly reduces the risk of ovarian cancer.

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

Signs and symptoms: Early ovarian cancer usually causes no obvious symptoms. However, some women experience persistent, nonspecific symptoms, such as back pain, bloating, pelvic or abdominal pain, difficulty eating or feeling full quickly, or urinary urgency or frequency in the months before diagnosis. Women who experience such symptoms daily for more than a few weeks should seek prompt medical evaluation. The most common sign of ovarian cancer is swelling of the abdomen caused by fluid accumulation (ascites) when the disease is advanced, when most women are diagnosed.

Treatment: Treatment includes surgery and often chemotherapy and targeted therapy. Surgery usually involves removal of both ovaries and fallopian tubes (bilateral salpingo-oophorectomy), the uterus (hysterectomy), and the omentum (fatty tissue attached to some of the organs in the abdomen), along with biopsies of the peritoneum (lining of the abdominal cavity). Additional abdominal organs may be removed in women with advanced disease, whereas only the involved ovary and fallopian tube may be removed in younger women with very early-stage tumors who want to preserve fertility. The goals of surgery are to remove as much of the tumor as possible, referred to as debulking, and accurately stage the cancer. Some women with advanced disease are candidates for chemotherapy administered directly into the abdomen (intraperitoneal). Targeted drugs can sometimes be used after other treatments to slow growth of advanced cancers or as maintenance treatment to keep the cancer from recurring after chemotherapy.

Survival: The 5-year relative survival rate for ovarian cancer is only 49%, largely because at least half of patients are diagnosed with distant-stage disease. For the 19% of women diagnosed with localized disease, the 5-year survival rate is 93% (Table 8). Five-year survival is nearly twice as high in women under age 65 (61%) as in those 65 and older (33%).

Pancreas

New cases and deaths: In 2022, an estimated 62,210 new cases of pancreatic cancer will be diagnosed in the US and 49,830 people will die from the disease (Table 1). More than 90% of cases develop in the exocrine tissue of the pancreas, which makes enzymes to digest food. The less common endocrine tumors, commonly referred to as pancreatic neuroendocrine tumors (NETs), develop in hormone-producing cells and have a younger median age at diagnosis and better prognosis.

Incidence trends: The incidence rate for pancreatic cancer has increased by about 1% per year since 2000.

Mortality trends: The death rate for pancreatic cancer has increased slightly (by 0.2% per year) since the mid-2000s.

Risk factors: People who smoke have about twice the risk of pancreatic cancer as never smokers. Use of smokeless tobacco also increases risk. Other risk factors include type 2 diabetes, excess body weight, a family history of pancreatic cancer, and a personal history of chronic pancreatitis. Heavy alcohol consumption may also increase risk. Individuals with Lynch syndrome and certain other genetic syndromes, including *BRCA1* and *BRCA2* mutation carriers, are also at increased risk.

Signs and symptoms: Signs and symptoms of pancreatic cancer, which usually do not appear until the disease is advanced, can include weight loss, abdominal discomfort that may radiate to the back, jaundice (yellowing of the skin and whites of the eyes), severe abdominal pain, nausea, and vomiting.

Treatment: Surgery, radiation therapy, and chemotherapy are treatment options that may extend survival and/or relieve symptoms, but seldom produce a cure. Fewer than 20% of patients are candidates for surgery because the cancer has usually spread beyond the pancreas at diagnosis. For those who do undergo surgery, adjuvant treatment with chemotherapy (and sometimes radiation) may lower the risk of recurrence and might help people live longer. For advanced disease, chemotherapy (sometimes along with a targeted therapy drug) or immunotherapy might be used. Clinical trials are testing several new targeted agents and immunotherapies.

Survival: For all stages combined, the 5-year relative survival rate is 11%. Even for the small percentage (13%) of people diagnosed with local disease, the 5-year survival rate is only 42%.

Prostate

New cases and deaths: In 2022, an estimated 268,490 new cases of prostate cancer will be diagnosed in the US and 34,500 men will die from the disease (Table 1). The incidence of prostate cancer is 73% higher in non-Hispanic Black men than in non-Hispanic White men for reasons that remain unclear.

Incidence trends: Changes in prostate cancer incidence rates largely reflect screening with the prostate-specific antigen (PSA) blood test, which mostly detects localized-stage disease. After declining during the late 2000s and early 2010s because of changes in screening guidelines followed by less PSA testing, rates from 2014 to 2018 were stable overall and for localized-stage disease, but increased by 4% to 6% annually for advanced-stage cancers.

Mortality trends: Prostate cancer death rates declined by about half from the mid-1990s to the mid-2010s due to earlier detection through PSA testing and advances in treatment. However, the decline has slowed in recent years, likely reflecting the uptick in distant-stage diagnoses; from 2015 to 2019, the rate decreased by 0.6% per year.

Risk factors: Well-established risk factors for prostate cancer are increasing age, African ancestry, a family history of the disease, and certain inherited genetic conditions (e.g., Lynch syndrome and *BRCA1* and *BRCA2* mutations). Black men in the US and Caribbean have the highest documented prostate cancer incidence rates in the world. The only modifiable risk factors are smoking and excess body weight, which may increase risk of aggressive and/or fatal disease.

Early detection: No major medical organization presently endorses routine screening for men at average risk because of concerns about the high rate of overdiagnosis (detecting disease that would never have caused symptoms or harm), along with the high potential for serious side effects associated with prostate cancer treatment. However, because prostate cancer is a leading cause of cancer death in men, many organizations recommend an "informed decision-making" approach whereby men are educated about screening and encouraged to make a personal choice. The American Cancer Society recommends that beginning at age 50, men who are at average risk of prostate cancer and have a life expectancy of at least 10 years have a conversation with their health care provider about the benefits and limitations of PSA testing and make an informed decision about whether to be tested. Black men and those with a close relative diagnosed with prostate cancer before the age of 65 should have this discussion beginning at age 45,

and men at even higher risk (several close relatives diagnosed at an early age and *BRCA* mutation carriers) should have this discussion beginning at age 40.

Signs and symptoms: Early-stage prostate cancer usually causes no symptoms. More advanced disease shares symptoms with benign prostate conditions, including weak or interrupted urine flow; difficulty starting or stopping urination; frequent urination, especially at night; blood in the urine; or pain or burning with urination. Late-stage prostate cancer commonly spreads to the bones, which can cause pain in the hips, spine, ribs, or other areas.

Treatment: Recent changes in the grading system for prostate cancer have improved tumor characterization and disease management. Careful monitoring of disease instead of immediate treatment (called active surveillance) is appropriate for many patients, particularly men who are diagnosed at an early stage, have less aggressive tumors, and are older. The main treatment options for early-stage disease include surgery, external beam radiation, or radioactive seed implants (brachytherapy). Focal therapies, in which only part of the prostate is treated, are being studied as well. Hormone therapy may be used along with surgery or radiation in locally advanced cases. Treatment often impacts a man's quality of life due to temporary or long-term side effects or complications, such as urinary and erectile difficulties. Current research is exploring new biologic markers for prostate cancer that could be used to minimize unnecessary treatment by distinguishing early-stage cancers that are more likely to progress if left untreated from those that are less likely to progress.

Late-stage prostate cancer treatment options include hormonal therapy, chemotherapy, and/or radiation therapy. Hormone treatment may control advanced prostate cancer for long periods of time by shrinking the size or limiting the growth of the cancer, thus helping to relieve pain and other symptoms. An option for some men with advanced prostate cancer that is no longer responding to hormones is a cancer vaccine designed to stimulate the patient's immune system to attack prostate cancer cells specifically. Other types of drugs can be used to treat prostate cancer that has spread to the bones.

Survival: The 5-year relative survival rate approaches 100% for the vast majority (84%) of men diagnosed with local- or regional-stage prostate cancer, but drops to 31% for those diagnosed with distant-stage disease (Table 8). The 10-year survival rate for all stages combined is 98%.

Skin

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

Invasive melanoma accounts for about 1% of all skin cancer cases, but the vast majority of skin cancer deaths. In 2022, an estimated 99,780 new cases of invasive and 97,920 cases of in situ melanoma will be diagnosed in the US, while 7,650 people will die from the disease (Table 1). Incidence rates are higher in women than in men before age 50, but thereafter are increasingly higher in men, largely reflecting age differences in historical occupational and recreational exposure to ultraviolet (UV) radiation, as well as use of indoor tanning among young women. Differences in early-detection practices and use of health care may also contribute.

Incidence trends: After decades of increase, invasive melanoma incidence rates declined from 2005 to 2018 in individuals younger than age 50 by about 1% per year and appear to have stablilized from 2014 to 2018 in adults 50 years of age and older.

Mortality trends: Melanoma mortality dropped steeply from 2015 to 2019 by about 4% per year because of advances in treatment.

Risk factors: A major risk factor for all types of skin cancer is light skin color, with melanoma incidence varying by about 4-fold among White individuals (e.g., rates are 3 times lower in those who are Hispanic) and by almost 30-fold between White and Black or Asian/Pacific

Islander individuals. Excess exposure to UV radiation from sunlight or use of indoor tanning also increases risk for all skin cancer types, as does a personal history of the disease. Risk of squamous cell carcinoma (SCC) is increased with a history of actinic keratosis, a precancerous lesion, or a weakened immune system, which also increases risk of melanoma. Additional melanoma risk factors include advanced age; a family history of the disease; and the presence of atypical, large, or numerous (more than 50) moles.

Prevention: Most skin cancer cases and deaths are caused by exposure to UV radiation, and thus are potentially preventable. Exposure to intense UV radiation can be minimized by wearing protective clothing (e.g., long sleeves, a wide-brimmed hat, etc.) and sunglasses that block UV rays; avoiding the sun at peak hours; applying broad-spectrum sunscreen that has a sun protection factor (SPF) of at least 30 to unprotected skin as directed; seeking shade; and not sunbathing or tanning indoors. Children and adolescents should be especially protected from the sun (and indoor tanning), as severe sunburns early in life may particularly increase risk of melanoma. Communities can help prevent skin cancer through educational interventions in schools and providing shade in communities and at schools, recreational sites, and occupational settings. In 2014, the US Surgeon General released a Call to Action to Prevent Skin Cancer because of the growing burden of this largely preventable disease. The purpose of this initiative is to increase awareness and encourage all Americans to engage in behaviors that reduce the risk of skin cancer. See surgeongeneral.gov/library/calls/prevent-skin-cancer/call-to-action-prevent-skin-cancer.pdf for more information. Additionally, people who have a high incidence of actinic keratosis may reduce risk of SCC with the use of medicated cream.

Early detection: The best way to detect skin cancer early is to be aware of new or changing skin spots or growths, particularly those that look unusual. Any new lesions, or a progressive change in a lesion's appearance (size, shape, color, new bleeding, etc.), should be evaluated promptly by a clinician. Periodic skin examination, preferably monthly and with the help of a partner for areas that are hard to see, may help identify changes.

Signs and symptoms: Warning signs of all skin cancers include changes in the size, shape, or color of a mole or other skin lesion; the appearance of a new skin growth; or a sore that doesn't heal. Changes that progress over a month or more should be evaluated by a clinician. Basal cell carcinoma may appear as a growth that is flat, or as a small, raised pink or red translucent, shiny area that may bleed following minor injury. Squamous cell carcinoma may appear as a growing lump, often with a rough surface, or as a flat, reddish patch that grows slowly. The ABCDE rule outlines warning signs of the most common type of melanoma: A is for asymmetry (one half of the mole does not match the other half); B is for border irregularity (the edges are ragged, notched, or blurred); C is for color (the pigmentation is not uniform); D is for diameter greater than 6 millimeters (about the size of a pencil eraser); and E is for evolution, meaning a change in the mole's appearance over time. Not all melanomas have these signs, so be alert for any new or changing skin growths or spots.

Treatment: Most cases of KC are cured by removing the lesion through minor surgery or other techniques (e.g., freezing). Radiation therapy and/or certain topical medications may also be used. For more advanced cancers (which are uncommon), immunotherapy or targeted drugs might be options. For melanoma, the primary growth and surrounding normal tissue are surgically removed, and sometimes a nearby lymph node is biopsied to determine stage; if these nodes contain cancer, more extensive surgery may be needed. Melanomas with deep invasion or that have spread to lymph nodes may be treated with surgery, immunotherapy, targeted drug therapy, and/or radiation therapy. The treatment of advanced melanoma has changed greatly in recent years with the development of several new immunotherapy and targeted drugs that can be very effective. Traditional chemotherapy may be used but is usually much less effective than newer treatments.

Survival: Almost all cases of KC (nonmelanoma skin cancer) can be cured, especially if detected and treated early. Although melanoma is also highly curable when detected in its earliest stages, it is more likely than KC to spread to other parts of the body. The 5-year relative survival rate for melanoma overall is 93%, ranging from

99% for cases diagnosed at a localized stage (78% of cases) to 30% for distant-stage disease (5% of cases) (Table 8); notably, distant-stage disease survival has doubled since 2004 (up from 15%) due to major advances in treatment.

Thyroid

New cases and deaths: In 2022, there will be an estimated 43,800 new cases of thyroid cancer diagnosed in the US and 2,230 people will die from the disease (Table 1). The incidence rate is almost 3 times higher in women than in men.

Incidence trends: Until recently, thyroid cancer was the most rapidly increasing cancer in the US, largely due to increased detection (probably including some overdiagnosis) of small papillary tumors (the most common subtype) as a result of increased imaging and more sensitive diagnostic procedures. However, due in part to the adoption of more conservative diagnostic criteria, the incidence rate declined by 2.5% per year from 2014 to 2018.

Mortality trends: The death rate for thyroid cancer was stable from 2010 to 2019.

Risk factors: Risk factors for thyroid cancer include being female, having a history of goiter (enlarged thyroid) or thyroid nodules, a family history of thyroid cancer, radiation exposure early in life (e.g., during cancer treatment), excess body weight, and certain rare genetic syndromes, such as familial adenomatous polyposis (FAP). People who test positive for a mutation in the RET gene, 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.

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 can 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 when an abnormality is seen on an imaging test done for another reason.

Treatment: Most thyroid cancers are highly curable, but about 3% (medullary and anaplastic thyroid cancers) are more aggressive and likely to spread to other organs. Treatment depends on patient age, tumor size and cell type, and extent of disease. Treatment is usually surgery to partially or totally remove the thyroid gland (thyroidectomy) and sometimes nearby lymph nodes. Radioactive iodine (I-131) treatment may be recommended after complete thyroidectomy for large tumors or when cancer has spread outside the thyroid to destroy any remaining thyroid tissue. Thyroid hormone replacement therapy is given after thyroidectomy to replace hormones normally made by the thyroid gland and to prevent the pituitary gland from producing thyroid-stimulating hormone, which lowers the likelihood of recurrence. For some types of advanced thyroid cancer, targeted drugs can be used to help shrink or slow tumor growth.

Survival: The 5-year relative survival rate is 98%, largely because two-thirds of cases are diagnosed at a local stage, but also because treatment is usually successful for most tumor types; among people diagnosed with distant-stage disease, more than half (53%) survive at least five years (Table 8).

Urinary Bladder

New cases and deaths: In 2022, an estimated 81,180 new cases of bladder cancer will be diagnosed in the US and 17,100 people will die from the disease (Table 1). The incidence rate is 4 times higher in men than in women and 2 times higher in White men than in Black men.

Incidence trends: After increasing slowly since the mid-1970s, bladder cancer incidence rates declined from 2009 to 2018 by about 1% per year.

Mortality trends: After decades of stable mortality, the death rate for bladder cancer declined from 2015 to 2019 by 1.7% per year.

Risk factors: Smoking is the most well-established risk factor for bladder cancer, accounting for almost half (47%) of all cases in the US. Risk is also increased among workers in the dye, rubber, leather, and aluminum industries; painters; people who live in communities with high levels of arsenic in the drinking water; and people with certain bladder birth defects or long-term urinary catheters.

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

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

Treatment: Surgery, alone or in combination with other treatments, is used in more than 90% of cases. Early-stage cancers may be treated by removing the tumor and then administering immunotherapy (BCG, or bacillus Calmette-Guérin) or chemotherapy drugs directly into the bladder (intravesical therapy). More advanced cancers may require removal of the entire bladder (cystectomy). This might be followed by immunotherapy, especially in people at higher risk for recurrence. Patient outcomes are improved with the use of chemotherapy before cystectomy. Distant-stage cancers are typically treated with chemotherapy, sometimes along with radiation. Immunotherapy and targeted therapy drugs are newer options, mainly when chemotherapy cannot be used or is no longer working. Timely follow-up care after treatment is extremely important for all patients because of the high likelihood of cancer recurrence, or a subsequent bladder cancer.

Survival: The 5-year relative survival rate for bladder cancer is 77% overall. About half (49%) of all cases are diagnosed before the tumor has spread beyond the layer of cells in which it developed (in situ), for which 5-year survival is 96%.

Uterine Cervix

New cases and deaths: In 2022, an estimated 14,100 cases of invasive cervical cancer will be diagnosed and about 4,280 deaths will occur in the US (Table 1).

Incidence trends: Cervical cancer incidence dropped by more than half from the mid-1970s to mid-2000s, largely due to the widespread uptake of screening with the Pap test, but remained stable during the most recent decade of data (2009 to 2018).

Mortality trends: Cervical cancer mortality has also dropped by more than half since the mid-1970s due to reductions in incidence and the early cancer detection through screening. From 2010 to 2019, the rate continued to decline by 0.8% per year.

Risk factors: Almost all cervical cancers are caused by persistent infection with certain types of human papillomavirus (HPV), although these infections are common in healthy people with a cervix and only rarely cause cancer. Individuals who begin having sex at an early age or have had many sexual partners or have male partners who have had many sexual partners are at increased risk for HPV infection, although infection can occur with 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, which gradually declines after cessation.

Prevention: HPV vaccination protects against the types of HPV that cause 90% of cervical cancers, as well as several other cancers and diseases. A population-based study recently demonstrated that the vaccine substantially reduces the risk of invasive cervical cancer, especially among women who were immunized before age 17 years. The American Cancer Society recommends routine vaccination between ages 9 and 12 years with catch-up vaccination for all persons through age 26 who are not adequately vaccinated. Unfortunately, the immunization rate remains low in the US; in 2020, 61% of

girls and 56% of boys 13 to 17 years of age were up to date with the HPV vaccination series. HPV vaccination cannot protect against established infections or all types of HPV, which is why it is important for all people with a cervix, even those who have been vaccinated, to follow cervical cancer screening guidelines.

Screening can prevent cervical cancer through detection and treatment of precancerous lesions, which are detected far more frequently than invasive cancer. Cancer can usually be prevented if an individual is screened regularly because most cervical precancers develop slowly. Historically, the only screening option was the Pap test, which is a simple procedure in which a small sample of cells is collected from the cervix and examined under a microscope. A newer option is the HPV test, which detects HPV infections associated with cervical cancer and can forecast cervical cancer risk. The HPV test can also identify individuals at risk for a type of cervical cancer called adenocarcinoma, which accounts for about 30% of cases and is more often missed by Pap tests than other subtypes.

Early detection: In addition to preventing cervical cancer, screening can detect invasive cancer early, when treatment is usually less intensive and more successful. Half of those diagnosed with cervical cancer have never been screened. The American Cancer Society recommends cervical cancer screening with a primary HPV test every 5 years for individuals ages 25 through 65 years who have a cervix and are at average risk of cervical cancer; only certain HPV tests are approved by the FDA for use as a primary test. If a primary HPV test is unavailable, co-testing (HPV testing in combination with Pap test) every 5 years or screening with a Pap test alone every 3 years is acceptable. For more detailed information on the American Cancer Society's screening guideline for the early detection of cervical cancer, see page 77.

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

Treatment: Precancerous cervical lesions may be treated with a loop electrosurgical excision procedure (LEEP), which removes abnormal tissue with a wire loop heated by electric current; cryotherapy (the destruction of cells by extreme cold); laser ablation (destruction of tissue using a laser beam); or conization (the removal of a cone-shaped piece of tissue containing the abnormal tissue). Early-stage cervical cancers are generally treated with surgery and/or radiation, sometimes combined with chemotherapy. Minimally invasive surgery (laparoscopy) is not often used because it is associated with worse survival than open surgery. Chemotherapy alone is often used to treat advanced disease. However, for women with metastatic, recurrent, or persistent cervical cancer, the addition of targeted therapy to standard chemotherapy has been shown to improve overall survival. Immunotherapy may be another option for metastatic or recurrent cancer.

Survival: The 5-year relative survival rate for cervical cancer is 66% overall, but ranges from 39% for Black women 65 years of age and older to 79% for White women under 50, and from 92% for localized-stage disease to 18% for distant-stage.

Uterine Corpus (Endometrium)

New cases and deaths: In 2022, an estimated 65,950 cases of cancer of the uterine corpus (body of the uterus) will be diagnosed in the US and 12,550 women will die from the disease (Table 1). Cancer of the uterine corpus is often referred to as endometrial cancer because more than 90% of cases occur in the endometrium (lining of the uterus).

Incidence trends: Incidence had increased by about 1% per year since the mid-2000s but may be stabilizing in recent data years.

Mortality trends: Mortality for uterine corpus cancer has risen since the mid-1990s, with an increase of 1% annually from 2015 to 2019, although rates appear to have stabilized in recent years.

Risk factors: According to American Cancer Society research, an estimated 70% of uterine corpus cancers are attributable to excess body weight and insufficient physical activity, and thus potentially preventable. Obesity and abdominal fatness each substantially increase the risk of uterine cancer, partly by increasing the amount of circulating estrogen, which is a strong risk factor. Other factors that increase estrogen exposure include the use of postmenopausal estrogen alone (continuous estrogen plus progestin does not appear to increase risk), late menopause, and a history of polycystic ovary syndrome. Tamoxifen, a drug used to treat/prevent breast cancer, increases risk slightly because of estrogen-like effects on the uterus. Medical conditions that increase risk include Lynch syndrome and type 2 diabetes. Pregnancy and use of oral contraceptives or intrauterine devices are associated with reduced risk.

Early detection: There are no recommended screening tests for women at average risk; however, most cases (66%) are diagnosed at an early stage because of postmenopausal bleeding. Women are encouraged to report any unexpected bleeding or spotting to a clinician. The American Cancer Society recommends that women with known or suspected Lynch syndrome be offered annual screening with endometrial biopsy and/or transvaginal ultrasound beginning at age 35.

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

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

Survival: The 5-year relative survival rate for uterine corpus cancer is 84% for White women but only 63% for Black women, partly because Black women are much more likely to be diagnosed with advanced-stage disease (38% versus 25%). Survival is lower for Black women for every stage at diagnosis.

Special Section: Cancer in the American Indian and Alaska Native Population

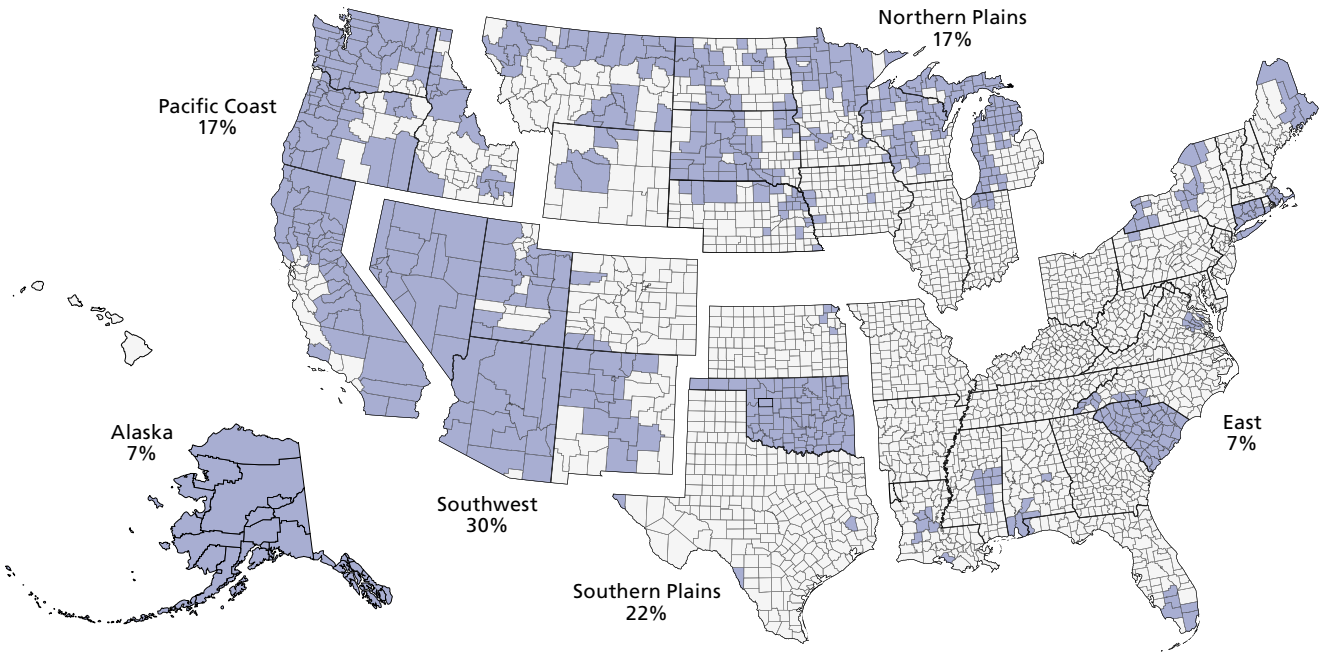
Introduction

In 2020, an estimated 9.7 million people identified as American Indian or Alaska Native (AIAN), representing about 3% of the US population.[1] According to the US Office of Management and Budget, the term AIAN refers to a person "having origins in any of the original peoples of North and South America (including Central America) and who maintains tribal affiliation or community attachment."[2] The AIAN population is incredibly diverse, with 574 federally recognized tribes and more than 200 that remain unrecognized, encompassing many distinct customs, languages, and history.[3-6]

At least in part because of genocide, forced displacement, and relocation perpetrated by US citizens and the military (e.g., the Indian Removal Act of 1830),[7-9] approximately two-thirds of AIANs live in tribal areas or surrounding counties, referred to as Purchased/Referred Care Delivery Area (PRCDA) counties. These counties are concentrated in the Western US and are more rural than non-PRCDA counties.[10, 11] There are 6 PRCDA regions: Alaska, East, Northern Plains, Pacific Coast, Southern Plains, and Southwest (Figure S1).

Continued systemic racism has resulted in limited access to health care, high-quality education, and economic opportunity for AIANs.[12,13] For example, people who are AIAN are twice as likely to live in poverty as those who are White, regardless of where they live (Table S1). In addition, although AIANs in PRCDA regions are served by the Indian Health Service (IHS), which was established in 1955 as part of ongoing payment for the coerced cession of tribal lands, they have the lowest health care

Figure S1. PRCDA Counties and the Distribution of American Indian and Alaska Native Persons by Region



PCRDA: Purchased/Referred Care Delivery Area. Percentages represent the proportion of the non-Hispanic American Indian/Alaska Native PRCDA population that lives in each region (shown in blue).

Source: US Census Bureau, 2019.

Table S1. Sociodemographic Characteristics and Health Care Access by Race and Census Region, US, 2019

Sociodemographic characteristics*

	American Indian/Alaska Native						White
	All	Northeast	Midwest	South	West	Alaska	All
Median age, years	32.9	34.8	32.0	34.1	32.0	28.5	40.1
Average household size (# of persons)	2.7	2.4	2.5	2.6	2.9	3.0	2.5
Poverty (%)†	20.3	18.2	23.9	19.1	20.2	19.7	10.5
Per capita income ($)‡	24,497	28,529	21,842	25,325	24,090	21,822	38,198
Educational attainment, ages ≥25 yrs (%)							
Less than high school graduate	15.6	16.4	13.6	15.5	16.3	11.6	9.6
High school graduate	28.3	26.3	30.3	27.7	28.3	40.7	26.9
Some college or associate's degree	35.3	30.6	67.3	34.3	36.4	33.8	29.1
Bachelor's degree or higher	20.8	26.7	18.8	22.5	19.0	13.9	34.4

Health care access (%)*

	Total US						Region§					
	All		Male		Female		Midwest		South		West	
	AIAN	White	AIAN	White	AIAN	White	AIAN	White	AIAN	White	AIAN	White
Uninsured, ages 18-64 yrs	27	10	38	11	18	10	25	9	29	15	25	9
No regular source of medical care	12	12	18	15	–	8	–	11	17	14	–	12

	All AIAN		American Indian		Alaskan Native	
Insurance status by IHS usage, ages ≥18 yrs	IHS	non-IHS	IHS	non-IHS	IHS	non-IHS
Uninsured	32	13	32	13	31	–
Private insurance	37	56	36	57	36	49
Public insurance	32	32	32	30	33	39

AIAN: American Indian and Alaska Native; IHS: Indian Health Service. Data are not restricted to Purchased/Referred Care Delivery Area counties. *Persons of Hispanic ethnicity are included in sociodemographic data due to data limitations but are excluded from health care access data. †Excludes persons in institutions, military group quarters, or college dormitories, and unrelated individuals under age 15 years. ‡Mean income computed for every man, woman, and child, including those living in group quarters. §Information by region is limited due to sparse data for AIANs. – Statistic not shown due to sparse data.

Sources: Sociodemographic characteristics – American Community Survey 1-year estimates, Selected Population Profiles 2019. Health care access – National Health Interview Survey, 2019. Insurance status by IHS usage – US Census Microdata, 2019.

coverage and health status of any population. This is in part because the IHS is chronically underfunded and understaffed.[14-16] Of the $48 billion per year required to fully fund the IHS, only $6.23 billion was budgeted for FY 2021.[17, 18] As a result, the IHS is unable to fully provide for the health care needs of those it serves, many of whom lack health insurance. Compared to their White counterparts, AIANs are more than twice as likely to be uninsured (Table S1), leaving many without access to care. Consequently, AIANs have a higher prevalence of many chronic health conditions than any other racial or ethnic group.[10] Further, AIANs are nearly 4 times more likely to be hospitalized with coronavirus disease 2019 (COVID-19) and twice as likely to die from the illness compared to White people.[19-21]

Despite these challenges, native communities demonstrate remarkable resiliency and tirelessly advocate for improved health care, self-governance, and fair and equitable treatment.[17, 22-24] This special section presents information on cancer among AIANs, including this population's unique challenges in accessing health care. Although cancer data by tribal affiliation are unavailable, differences between PRCDA regions are described when possible to shed light on the substantial heterogeneity of the cancer burden within this population. Cancer statistics are presented for non-Hispanic AIAN individuals residing in PRCDA counties to minimize racial misclassification (see sidebar on page 32).

Cancer Occurrence among AIANs

Incidence

Nationally, cancer incidence among AIANs is higher than among Whites for lung, colorectal, and kidney cancers, as well as cancers associated with infectious agents (liver,

Improving the Accuracy of Cancer Statistics for American Indians and Alaska Natives

American Indians and Alaska Natives (AIANs) have the highest racial misclassification in health data of any group,[25-27] which results in an underestimation of disease burden when left unaddressed. One method of improving accuracy is data linkage with the Indian Health Service (IHS), which provides health care to approximately 2.6 million AIANs in 25 states.[28] IHS linkage has been shown to increase cancer incidence and mortality rates by 30% or more.[29-31] Although IHS-linked cancer incidence data are publicly available, IHS-linked cancer mortality data are housed at the Centers for Disease Control and Prevention (CDC) and unavailable to external researchers. Thus, because of the high percentage of misclassification on death certificates, we were unable to include high-quality mortality data in this special section. The lack of broad availability of IHS-linked mortality data hinders the much-needed promotion of cancer prevention and control for this underserved population.

Misclassification is additionally reduced by restricting analyses to non-Hispanic individuals residing in Purchased/Referred Care Delivery Area (PRCDA) counties, where receipt of care through the IHS is most common.[31, 32] Hispanic ethnicity exclusion improves precision because bridged race intercensal population estimates used to calculate disease rates have overestimated the number of Hispanic AIANs since 2010.[33, 34] All cancer incidence data presented in this report are confined to non-Hispanic AIANs residing in PRCDA counties and have gone through linkage with IHS enrollment files. The Urban Indian Health Institute and American Indian Cancer Foundation are working to further reduce misclassification in health data, which will especially improve representation of AIANs living in urban settings.[35]

stomach, cervix; Table S2). These racial disparities are similar regardless of whether the comparison is with Whites overall or those residing in PRCDA counties. However, cancer risk and disparities vary substantially by PRCDA region. For example, incidence of lung cancer, the most commonly diagnosed cancer among AIANs, ranges from 16.8 cases per 100,000 in the Southwest (Figure S2), where it is 64% lower than in Whites (Table S3), to 109.3 in the Northern Plains, where it is 80% higher than in Whites. For all cancers combined, rates among AIANs range from 323.2 cases per 100,000 persons in the Southwest (23% lower than in Whites) to 666.7 in the Southern Plains (49% higher than in Whites). However, incidence in AIANs is most favorable compared to Whites in the East region (29% lower), partly because rates among Whites there are the highest of any PRCDA region.

Stage Distribution and Survival

Cancer is generally diagnosed at a later stage in AIANs than in Whites, with some of the largest disparities for breast and stomach cancers (Figure S3). Consequently, 5-year relative survival rates are lower among AIANs than Whites for most cancer types (Figure S4). The largest difference is for stomach cancer, for which 5-year survival is 19% among AIANs versus 32% among Whites. Importantly, these disparities are likely underestimated because of racial misclassification and other biases that undermine accurate cancer statistics for indigenous and other non-White populations.[36]

Later-stage diagnosis and lower survival among AIANs likely reflect less access to high-quality health care and other obstacles to early detection and treatment.[37-39] Although the IHS is a health care option for many, it is not health insurance and thus, not governed by legislative protections like the Affordable Care Act. As a result, the IHS has limited "specialty services," such as cancer screening.[40, 41] A 2005 report of 13 IHS facilities found that more than half did not have recommended colonoscopy services.[42] (See Cancer Screening in AIANs, page 41.)

In addition, more than half (54%) of AIANs live in rural areas or small towns,[43] where access to health care professionals, hospital services, and specialty care is limited.[44, 45] Increased distance to providers is an even greater challenge for rural residents who are poor.[46]

Selected Cancers

Breast (female)

Incidence: Breast cancer is the most commonly diagnosed cancer in AIAN women, as it is in the general population (Table S2).[47, 48] Disparities in incidence between AIAN and White women vary regionally, ranging from 45% lower than Whites in the Southwest (69.9 versus 126.7 per 100,000) to 35% higher in the Southern Plains (166.8 versus 123.6 per 100,000, Table S3). These differences likely reflect regional variation in obesity prevalence (Table S4) and reproductive factors that influence breast cancer risk, such as age at first birth[49] and use of oral contraceptives and menopausal hormone therapy.[16, 50-52] (See page 11 for information about how these factors influence breast cancer risk.) Differences in the prevalence and quality of breast cancer screening also likely contribute (see Cancer Screening in AIANs, page 41). Breast cancer incidence rates have been increasing slowly for over a decade among women overall, but appear to have stabilized in recent years among AIAN women (Figure S6).

Stage at diagnosis and survival: The 5-year relative survival rate for breast cancer is 90% among AIAN women (Figure S4). AIAN women are less likely than White women to be diagnosed with localized-stage disease (59% versus 67%, Figure S3) and have a higher prevalence of triple-negative tumors (estrogen- and progesterone-receptor negative and human epidermal growth factor receptor 2-negative), which have the lowest survival rate of all major breast cancer subtypes.[53-54] Biennial mammography rates are lower among AIAN than White women nationally (62% versus 72%, Table S5), and are lower still in AIAN women receiving care at IHS facilities (55% in women ages 52-64 years, Table S6).[55]

Colon and Rectum

Incidence: Colorectal cancer (CRC) is the third most commonly diagnosed cancer among all AIAN men and women (Table S2) but is the second most commonly diagnosed cancer among Alaska Native men and women, who have the highest incidence globally.[56-58] Incidence rates among AIANs regionally range from similar to those in Whites in the East to more than 2.5-fold higher in Alaska (91.3 versus 35.5 cases per 100,000, Table S3). Elevated rates among AIANs may reflect higher prevalence of cigarette smoking and obesity (Table S4) and lower receipt of CRC screening (Table S5),[59] which allows for detection and removal of precancerous lesions. Additional factors specific to Alaska Natives may include vitamin D deficiency due to less sun exposure and a diet low in dietary fiber, fruits, and vegetables.[60] In contrast to rapid declines in CRC incidence among Whites in recent decades, rates among AIANs have decreased very slowly, by about 0.5% per year from 1998 through 2018 (Figure S6).[30]

Stage at diagnosis and survival: Five-year relative survival for CRC is similar in AIANs and Whites when diagnosed at the same stage (Figure S4). However, AIANs are less likely to be diagnosed with localized-stage disease (32% versus 35%, respectively, Figure S3). Later-stage diagnosis likely relates in part to lack of colonoscopy services at many IHS and other health care facilities that serve AIAN patients (see Cancer Screening in AIANs, page 41).[61] Only 41% of persons ages 50-75 years who used IHS services (Table S6)[55] and 56% of AIANs overall are up-to-date for CRC screening versus 69% of Whites (Table S5).

Kidney and Renal Pelvis

Incidence: Kidney cancer incidence rates are about 80% higher in AIANs than in Whites (31.6 versus 17.7 cases per 100,000, Table S2), and are likewise elevated in all regions except the East.[62] This pattern likely reflects the higher prevalence among AIANs of obesity (Table S4), which accounts for one-third of cases in the general population.[63] Additional factors that may contribute include a higher prevalence of cigarette smoking, type 2 diabetes, kidney disease, and hypertension.[64, 65] In particular, AIANs have

IHS Areas

The IHS has 12 service areas named for the location of their headquarters: Alaska, Albuquerque, Bemidji, Billings, California, Great Plains, Nashville, Navajo, Oklahoma, Phoenix, Portland, and Tucson. Each catchment area provides health care to a unique group of tribes with different geographic challenges. For more information, including a map of IHS facilities, visit https://www.ihs.gov/locations/.

the highest rates of type 2 diabetes of any major racial/ethnic group in the US,[66, 67] which increases kidney cancer risk independent of excess body weight.[68] Kidney cancer incidence has been increasing rapidly since 1998 among AIANs (Figure S7); from 2009-2018, the rate increased by 2.8% per year, compared to 1.1% per year among Whites.[30]

Stage at diagnosis and survival: AIAN individuals have similar kidney cancer stage distribution to Whites (Figure S3), despite lower overall 5-year relative survival rates (Figure S4). This may reflect less access to high-quality treatment among AIANs and/or differences in cancer subtype distribution.

Liver and Intrahepatic Bile Duct

Incidence: AIANs have the highest liver cancer incidence of any major racial/ethnic group in the US,[69, 70] with rates 2.5 times higher than those in Whites overall (19.1 versus 7.4 cases per 100,000, Table S2) and more than 3 times higher in the Northern Plains and in the Southwest among women.[62] Rates are elevated among AIANs in nearly every region, likely reflecting a high prevalence of risk factors, including obesity, diabetes, cigarette smoking, and chronic hepatitis C virus (HCV) infection, the strongest risk factor for liver cancer.[71] Improving access to health care and antiviral medications is needed to reduce liver cancer incidence among AIANs.[72] An estimated 7 in 10 cases among the general population are due to modifiable risk factors, and thus potentially preventable.[63]

Liver cancer incidence has been increasing for decades in the US, largely because of the HCV epidemic associated with the use of contaminated needles for intravenous drug use among baby boomers (see additional information on liver cancer in the general population on page 17). However, rates appear to be stabilizing in recent years among AIAN individuals, especially men, similar to the pattern overall.[30]

Stage at diagnosis and survival: Liver cancer is one of the most fatal cancer types, with a 5-year relative survival rate of 17% among AIANs and 19% among Whites. AIANs and Whites have similar stages of diagnosis (Figure S3).

Table S2. Comparison of Cancer Incidence Rates in American Indians and Alaska Natives (AIAN) in PRCDA counties with Whites Nationally, US, 2014-2018

		AIAN	White	RR
All sites	Total	488.3	477.9	1.02*
	Male	515.0	514.2	1.00
	Female	473.3	454.0	1.04*
Breast	Female	119.1	134.7	0.88*
Colon & rectum†	Total	52.4	36.7	1.43*
	Male	59.4	42.2	1.41*
	Female	46.7	31.8	1.47*
Esophagus	Total	5.5	5.1	1.09
	Male	9.5	8.8	1.09
	Female	2.3	1.9	1.22
Kidney & renal pelvis	Total	31.6	17.7	1.79*
	Male	41.7	24.0	1.73*
	Female	23.4	12.1	1.93*
Liver & intrahepatic bile duct	Total	19.1	7.4	2.59*
	Male	27.9	11.2	2.49*
	Female	11.8	4.0	2.93*
Lung & bronchus	Total	66.4	62.5	1.06*
	Male	73.0	70.0	1.04*
	Female	61.5	56.8	1.08*
Oral cavity & pharynx	Total	12.8	13.5	0.95
	Male	19.6	20.5	0.96
	Female	7.0	7.2	0.98
Pancreas	Total	14.4	13.2	1.09*
	Male	16.7	15.3	1.09
	Female	12.6	11.4	1.10
Prostate	Male	89.1	104.9	0.85*
Stomach	Total	10.3	5.3	1.92*
	Male	13.4	7.5	1.78*
	Female	7.9	3.5	2.24*
Uterine cervix	Female	11.5	7.4	1.56*

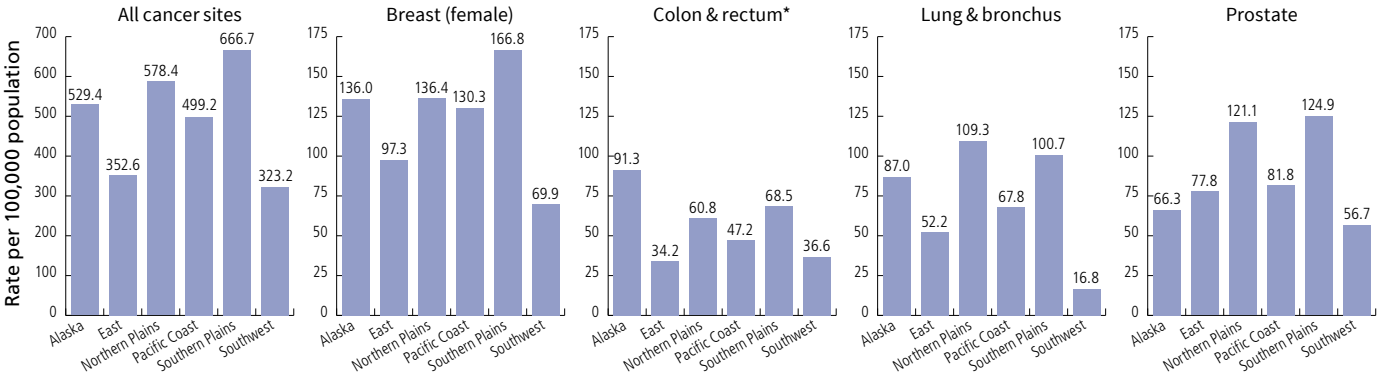
PRCDA: Purchased/Referred Care Delivery Area; RR: incidence rate ratio. All rates are per 100,000 non-Hispanic persons, age-adjusted to the 2000 US standard population, and adjusted for delays in reporting. Rate ratios represent the unrounded incidence rate in AIANs living in PRCDA counties divided by the unrounded incidence rates in Whites nationally. *The rate in AIANs is statistically significantly different from that in Whites ($p \leq 0.05$). †Excludes appendix.

Source: NAACCR, 2021.

Lung and Bronchus

Incidence: Lung cancer is the second most commonly diagnosed cancer in AIAN men and women (Table S2). As mentioned previously, incidence rates vary dramatically by region, from less than 20 per 100,000 in the Southwest to greater than 100 per 100,000 in the Northern and Southern Plains (Figure S2). Rates are also high in Alaska (87 per 100,000), where they are 59% higher than those in Whites. In contrast to higher incidence in men than in

Figure S2. Incidence Rates for Selected Cancers among American Indians and Alaska Natives by PRCDA Region, US, 2014-2018



PRCDA: Purchased/Referred Care Delivery Area. All rates are age-adjusted to the 2000 US standard population and are adjusted for delays in reporting. Rates exclude persons of Hispanic ethnicity. *Excludes appendix. NOTE: The vertical scale varies across graphs to optimize the display of data.

Source: NAACCR, 2021.

women among other racial and ethnic groups (Table 9), rates among AIAN women are comparable to those in men in the East and Pacific Coast and higher than those among men in the Northern Plains (111.5 versus 106.2 per 100,000).

This wide variation reflects historical differences in smoking prevalence.[73] Although smoking has typically been more common in men than in women, the reverse is true among AIANs, with current prevalence 27% in women versus 24% in men (Table S4). Both historically and contemporarily, AIANs have the highest smoking prevalence and the fewest quit attempts of any major racial/ethnic group in the US.[74-77] The relative gap in smoking prevalence between AIANs and Whites has widened from 30% in the early 1990s to 56% in 2019 (Figure S7). Reasons for the higher rates of smoking in AIANs are complex and include lower socioeconomic status (SES),[78] targeted advertising,[79, 80] deceptive tobacco product marketing,[81] and the cultural importance of tobacco in some regions.[82] (See Tobacco Use on page 52 for more information.)

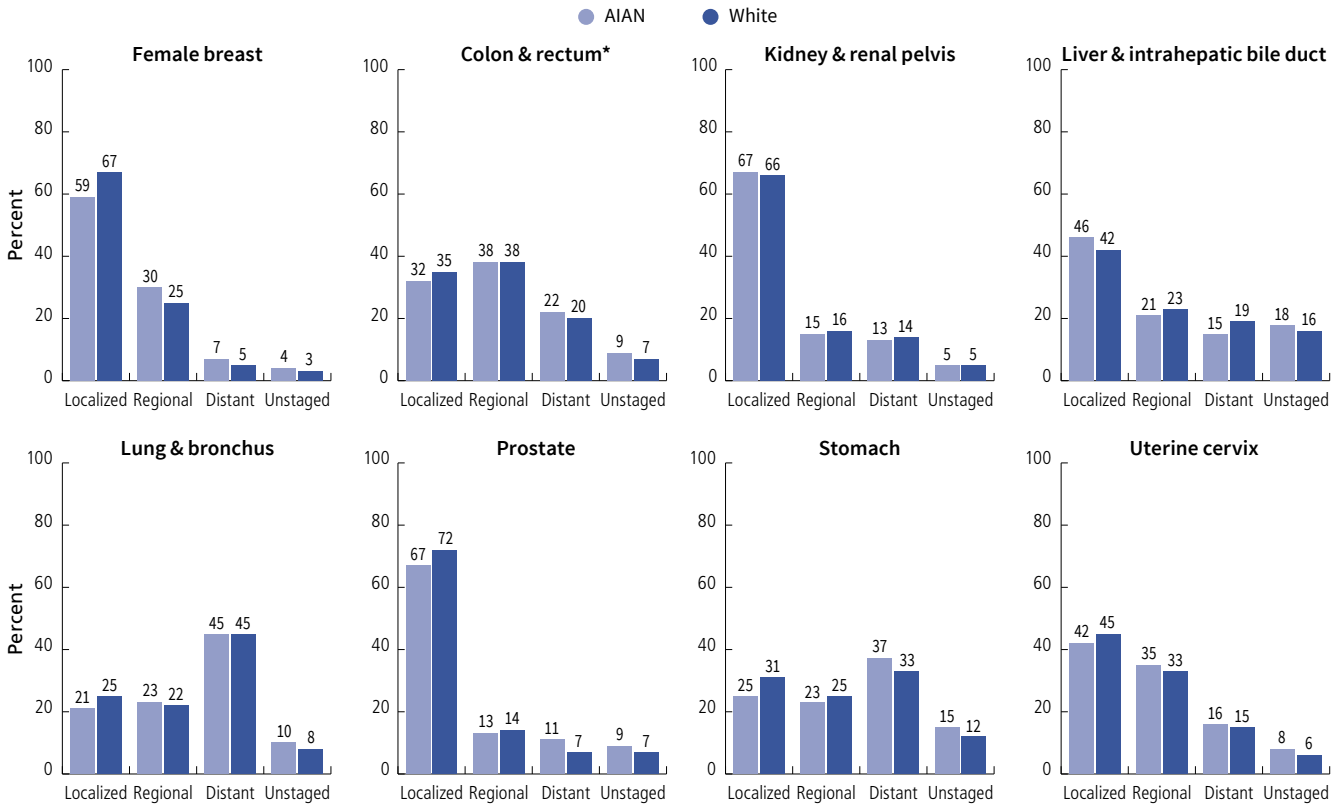
Table S3. Incidence Rates for the Four Most Common Cancers by PRCDA Region and Sex among American Indians and Alaska Natives versus Whites, 2014-2018

		Alaska			East			Northern Plains			Pacific Coast			Southern Plains			Southwest		
		AIAN	White	RR	AIAN	White	RR	AIAN	White	RR	AIAN	White	RR	AIAN	White	RR	AIAN	White	RR
All sites	Total	529.4	437.6	1.21*	352.6	495.7	0.71*	587.4	464.6	1.26*	499.2	457.6	1.09*	666.7	447.9	1.49*	323.2	422.0	0.77*
	Male	543.3	459.8	1.18*	354.4	537.6	0.66*	618.7	500.3	1.24*	509.4	485.2	1.05*	720.6	486.5	1.48*	341.1	447.6	0.76*
	Female	529.2	420.7	1.26*	354.5	467.1	0.76*	566.9	439.6	1.29*	496.4	439.9	1.13*	632.8	421.3	1.50*	315.1	403.4	0.78*
Breast	Female	136.0	129.2	1.05	97.3	139.9	0.70*	136.4	130.2	1.05	130.3	134.9	0.97	166.8	123.6	1.35*	69.9	126.7	0.55*
Colon & rectum†	Total	91.3	35.5	2.57*	34.2	35.6	0.96	60.8	36.0	1.69*	47.2	34.0	1.39*	68.5	38.0	1.81*	36.6	31.6	1.16*
	Male	89.4	40.1	2.23*	32.9	40.8	0.81	74.5	41.0	1.82*	49.8	38.3	1.30*	80.6	44.3	1.82*	43.3	36.1	1.20*
	Female	91.8	30.7	2.99*	35.6	30.9	1.15	50.3	31.5	1.60*	45.5	30.0	1.52*	58.5	32.4	1.81*	31.2	27.4	1.14
Lung & bronchus	Total	87.0	54.6	1.59*	52.2	65.2	0.80*	109.3	60.6	1.80*	67.8	53.1	1.28*	100.7	66.7	1.51*	16.8	46.4	0.36*
	Male	97.8	61.7	1.59*	51.7	71.4	0.72*	106.2	67.8	1.56*	67.8	56.4	1.20*	120.8	78.2	1.55*	21.6	50.1	0.43*
	Female	79.3	47.7	1.66*	52.7	60.6	0.87	111.5	55.1	2.02*	68.0	50.6	1.34*	85.5	57.7	1.48*	13.6	43.3	0.31*
Prostate	Male	66.3	99.6	0.67*	77.8	113.1	0.69*	121.1	107.9	1.12*	81.8	98.7	0.83*	124.9	93.4	1.34*	56.7	92.7	0.61*

AIAN: American Indian and Alaska Native; PRCDA: Purchased/Referred Care Delivery Area; RR: incidence rate ratio. All rates are per 100,000 non-Hispanic persons diagnosed in PRCDA counties (including for Whites); age-adjusted to the 2000 US standard population; and adjusted for delays in reporting. Rate ratios represent the unrounded incidence rate in American Indians and Alaska Natives divided by that in Whites. *The rate in American Indians and Alaska Natives is statistically significantly different from that in Whites ($p \leq 0.05$). †Excludes appendix.

Source: NAACCR, 2021.

Figure S3. Stage at Diagnosis (%) for Selected Cancers by Race, US, 2014-2018



AIAN: American Indian and Alaska Native. Data for AIANs are restricted to patients diagnosed in Purchased/Referred Care Delivery Area counties. Data for Whites and AIANs exclude persons of Hispanic ethnicity. Percentages may not total 100% due to rounding. *Excludes appendix.

Source: NAACCR, 2021.

Lung cancer incidence in the general population has been declining since the early 1990s among men and the mid-2000s among women.[30] In contrast, rates in AIANs since the late 1990s remained generally stable in women and only began to decline recently in men (by 5.4% per year during 2014 through 2018, Figure S5).

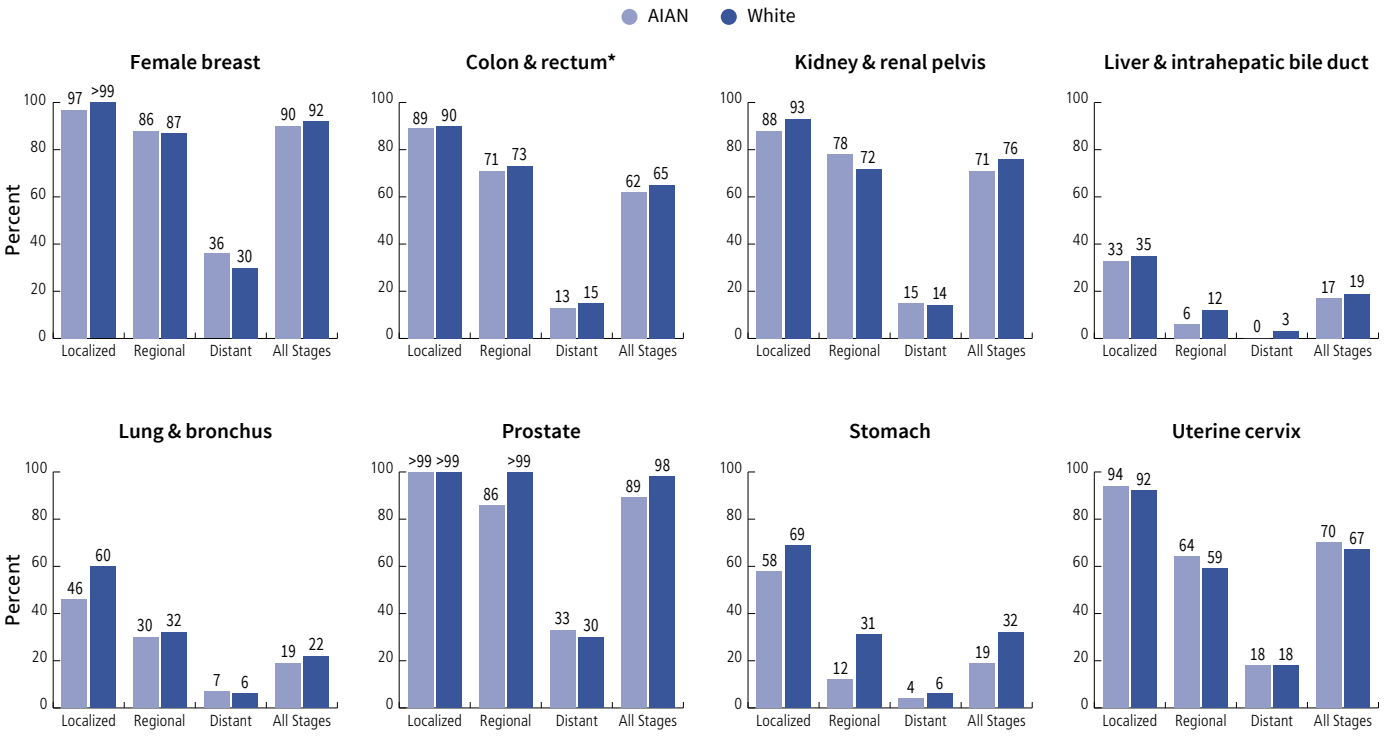
Stage at diagnosis and survival: Five-year relative survival for lung cancer is 19% among AIANs compared to 22% among Whites (Figure S4). Localized-stage disease is diagnosed less often in AIANs compared to Whites (21% versus 25%, Figure S3), and also has the largest racial gap in 5-year relative survival, 46% versus 60%.

Prostate

Incidence: Prostate cancer is the most commonly diagnosed cancer in AIAN men (Table S2). Incidence rates range from 56.7 per 100,000 in the Southwest to 124.9 in the Southern Plains and are lower than those in White men in most regions (Table S3). Regional incidence patterns likely reflect differences in screening with the prostate specific antigen (PSA) test, which detects asymptomatic, often indolent, cancers. The only established risk factors for prostate cancer are older age, a family history of the disease, and African ancestry (see information on prostate cancer in the general population on page 23). PSA screening rates are lower among AIAN men than other racial/ethnic groups, suggesting that overdiagnosis contributes to higher rates among White men.[83]

Fluctuations in prostate cancer incidence reflect changes in uptake of routine PSA testing, coinciding with changes in the USPSTF screening recommendations. Rates declined from 2008-2014 in the wake of recommendations against routine PSA testing, but have stabilized in recent years.[30]

Figure S4. Five-year Relative Survival for Selected Cancers by Race and Stage at Diagnosis, US, 2011-2017



AIAN: American Indian and Alaska Native. Survival rates are for patients diagnosed during 2011-2017, all followed through 2018. All rates exclude patients of Hispanic ethnicity. Rates for American Indians and Alaska Natives are confined to patients diagnosed in Purchased/Referred Care Delivery Area counties. *Excludes appendix.

Source: SEER 18 registries, 2021.

Stage at diagnosis and survival: The 5-year relative survival rate for prostate cancer is lower in AIAN than White men (89% versus 98%, Figure S4), likely in part reflecting the lower proportion of localized disease diagnosed in AIAN men (67% versus 72%, Figure S3). Notably, 5-year survival rates for men diagnosed with regional-stage disease are 86% among AIANs while approaching 100% in Whites.

Stomach

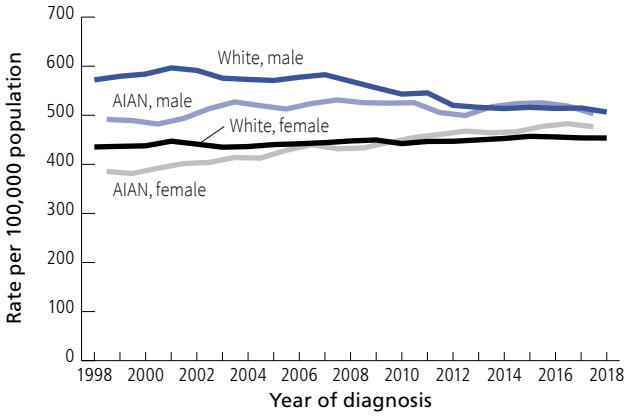
Incidence: Stomach cancer incidence in AIANs is double that in Whites (10.3 versus 5.3 cases per 100,000, Table S2) nationally and is particularly elevated in Alaska, where rates are more than 4 times higher.[65] *Helicobacter pylori* infection, the principal risk factor for stomach cancer, [63, 84] is most common in persons with lower SES and is especially prevalent in Alaska Natives.[85, 86] Cigarette smoking and obesity also likely contribute to excess risk among AIANs (Table S4).[87, 88] From 2009 to 2018, incidence rates were stable among AIAN women, but decreased by 1.4% per year among AIAN men.[30]

Stage at diagnosis and survival: The 5-year relative survival rate for stomach cancer is lower among AIANs than Whites overall and for every stage of diagnosis, with the largest gap for regional-stage disease (12% versus 31%, Figure S4). AIANs are also less likely than Whites to be diagnosed with localized-stage disease (25% versus 31%, Figure S3).

Uterine Cervix

Incidence: Cervical cancer incidence rates are 56% higher among AIAN women (11.5 cases per 100,000, Table S2) than White women (7.4), reflecting higher underlying prevalence of persistent infection with human papillomavirus (HPV) and less access to screening, which can prevent cancer.[89] Rates among AIAN women are elevated in all PRCDA regions except for the East and Southwest,[65] likely reflecting

Figure S5. Trends in Age-adjusted Cancer Incidence Rates* by Sex and Race, US, 1998-2018



AIAN: American Indian and Alaska Native. *Rates are age adjusted to the 2000 standard population, adjusted for delays in reporting, and exclude persons of Hispanic ethnicity. Rates for AIANs are restricted to Purchased/Referred Care Delivery Area counties and are two-year moving averages due to data sparseness.

Source: NAACCR, 2021.

regional variation in HPV rates and screening. Vaccination against HPV infections that cause the majority of cervical cancers has been available since 2006; data from 2019 show that HPV vaccination is suboptimal among both AIAN and White adolescents (see more information on HPV on page 41).[90] Although screening with the Pap test has led to historical declines in incidence among all women, trends have leveled off in recent years. From 2009 to 2018, cervical cancer incidence rates were stable in both AIAN and White women.[30]

Stage at diagnosis and survival: Five-year relative survival is 70% among AIAN women, similar to that in White women (Figure S4) despite a lower likelihood of localized-stage disease (42% versus 45%, Figure S3) and cervical cancer screening (Table S5). Screening is particularly low among women utilizing IHS services, with only 55% of women ages 24-64 years up to date on screening in 2017 (Table S6, see Cancer Screening in AIANs, page 41).[55] Persistently low screening prevalence may help explain the survival paradox in AIAN women because populations that are less screened have a higher proportion of squamous cell carcinoma, which has better survival, and a lower proportion of adenocarcinoma, which has worse outcomes.[91-93]

Prevalence of Major Cancer Risk Factors

More than 40% of all cancers in the general population are attributable to potentially modifiable risk factors such as tobacco use, excess body weight, excess alcohol consumption, and infectious agents.[63] Prevalence of these risk factors and their associated cancer burden varies substantially by region and could help inform priorities for local cancer control programs. Unfortunately, however, risk factor data are not available for PRCDA counties specifically and are herein presented by census region to approximate PRCDA regions. If national health surveys targeted residents of PRCDA counties and oversampled AIANs, the accuracy of AIAN health behavior data would improve and cancer control and prevention in this population would be facilitated.

Tobacco

Cigarette smoking is the single largest contributing risk factor to cancer in the United States.[63] One-quarter of AIAN adults were current smokers in 2019, more than any other major racial/ethnic group,[75] with rates 1.5 times higher than in White adults (Table S4). Notably, smoking prevalence is higher among AIAN women than men (27% versus 24%), whereas it is currently the same among White men and women (16%). Smoking prevalence is lower among people who live in the West census region than in the Midwest or South and among those with higher educational attainment. For example, among AIANs, prevalence in 2010-2015 was more than twice as high in persons with less than a high school diploma (45.1%) as in those with at least a college degree (13.1%).[79] Tobacco use has cultural importance in social relationships and spiritual and medicinal ceremonies among some AIAN tribes.[82]

Tobacco Control and Cessation

Cigarettes are less expensive on tribal lands because they are not subject to state excise tax.[81] Additionally, the tobacco industry directly targets AIAN communities through the use of culturally specific names, symbols, and icons in their marketing.[79, 80] Most importantly, improving the social determinants of health, such as

Table S4. Prevalence of Cancer Risk Factors (%) among Ages ≥18 Years by Race, Sex, and Region, US, 2016-2019

	Total US						Region*					
	Both sexes		Male		Female		Midwest		South		West	
	AIAN	White	AIAN	White	AIAN	White	AIAN	White	AIAN	White	AIAN	White
Smoking (NHIS 2019)												
Current	25	16	24	16	27	16	27	17	27	18	21	13
Former	22	25	29	29	17	22	28	25	23	26	20	24
Never	52	59	47	55	56	62	46	58	50	56	59	63
Alcohol use (NHIS 2016 & 2018)												
Binge drinking†	23	31	32	37	16	27	29	36	26	27	21	31
Heavy drinking‡	6	6	8	6	–	7	–	6	10	6	5	8
Excess body weight (NHIS 2019)												
Overweight/obese (BMI ≥25.0 kg/m^2)	73	64	76	71	70	57	62	67	71	65	77	59
Overweight (BMI = 25.0-29.9)	33	33	38	39	28	27	29	33	30	32	34	32
Obese (BMI ≥30.0)	40	31	38	33	41	30	32	35	42	32	43	27
Physical activity (NHIS 2018)												
No leisure time physical activity	23	22	24	20	23	23	35	22	30	26	13	16
Met recommended levels of aerobic activity	52	58	59	61	46	55	45	55	43	54	66	65

BMI: body mass index; AIAN: American Indian and Alaska Native. All estimates are age adjusted. Data exclude persons of Hispanic ethnicity and are not restricted to Purchased/Referred Care Delivery Area counties. *Information by region is limited due to sparse data for AIANs. †Includes men who have had ≥5 drinks/women who have had ≥4 drinks in one day at least once during the past year (among current drinkers). ‡Men who consume >14 drinks per week and women who consume >7 drinks per week. – Estimate not provided due to sparse data.

Source: National Health Interview Survey (NHIS), 2016, 2018, and 2019.

economic stability and access to high-quality education, are critical for reducing cigarette smoking in AIAN populations because low SES and income are closely associated with tobacco use.

Excess Body Weight

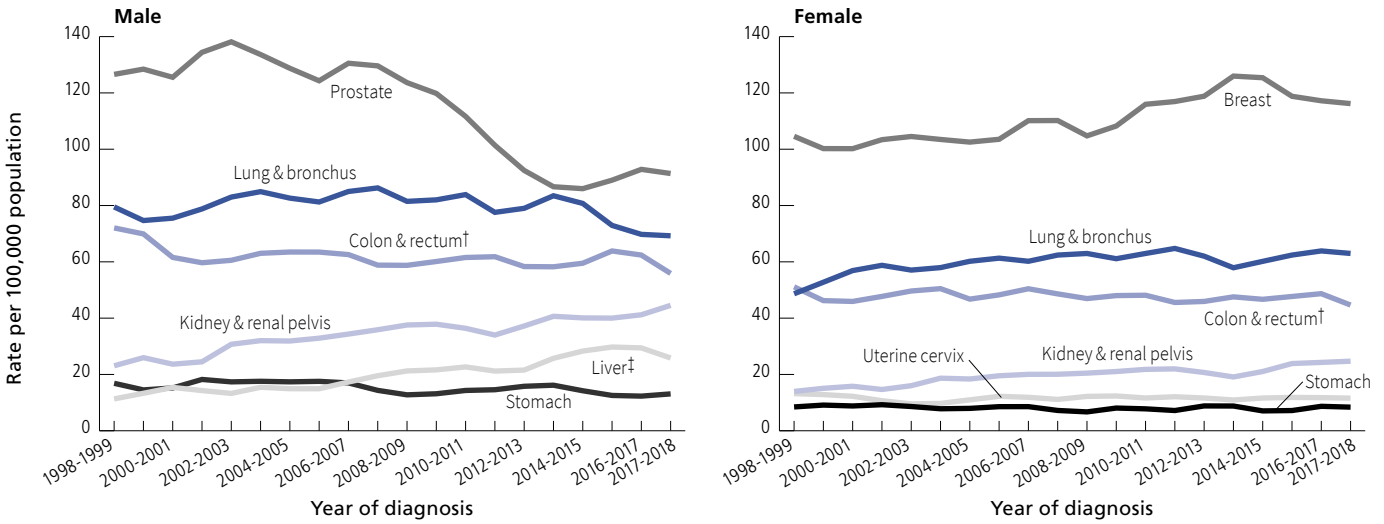
Excess body weight increases the risk of several cancers and contributes to the development of other cancer risk factors, such as nonalcoholic fatty liver disease and type 2 diabetes. Normal weight is defined as body mass index (BMI, kg/m^2) of 18.5-24.9, while overweight is 25-29.9 and obese is ≥30. AIAN persons are more likely to be obese than Whites (40% compared to 31% overall, Table S4), except for those in the Midwest census region (32% versus 35%).

Many factors contribute to high obesity in the AIAN population, but a primary cause is low access to healthy food because of disproportionate poverty and rural residence. The Food Distribution Program on Indian Reservations was implemented as a solution to limited grocery store access, but contributes to increased obesity by supplying highly processed, high-calorie shelf-stable foods.[3] Food insecurity is also a major factor in excess body weight among urban AIANs.[11] Ironically, the traditional native American diet of high fruit and vegetable consumption[16] and low intake of simple carbohydrates and fats is associated with reduced risk of obesity and chronic disease,[94-96] but is largely unavailable because of barriers related to historical injustice and continued racism as previously described.[3] Improving food sovereignty and expanding access to locally grown food could significantly improve overall nutrition and reduce obesity in the AIAN population.

Diabetes

Type 2 diabetes increases the risk of several cancers, including colorectal and kidney.[97] The prevalence of type 2 diabetes is twice as high in AIAN adults than in White adults.[16] Promisingly, among AIANs utilizing IHS services, rates of diabetes declined from 2013-2017 after increasing in previous years.[98] However, rates among AIAN youth increased significantly from 2003-2012, with the rate in 2012 more than 10 times higher than in White youth.[99] Excess body weight contributes to the high rates and earlier onset of diabetes in the AIAN population.[100, 101] Low SES and food insecurity, both of which are elevated among AIANs (Table S1),[11, 102] are associated with type 2

Figure S6. Trends in Cancer Incidence Rates* by Sex and Site among American Indians and Alaska Natives, 1998-2018



*Age-adjusted to the 2000 US standard population, adjusted for reporting delays, and restricted to non-Hispanic persons in Purchased/Referred Care Delivery Area counties. Rates are 2-year moving averages due to sparse data. †Excludes appendix. ‡Includes intrahepatic bile duct.

Source: NAACCR, 2021.

diabetes,[103] and are of particular concern for urban AIAN households due to the high prevalence of food deserts in high-poverty neighborhoods.[3]

Alcohol

Alcohol consumption is associated with an increased risk of several cancers.[104] Overall binge drinking (>4 drinks in one day for men or >3 drinks in one day for women) is lower among AIANs than in Whites, whereas the prevalence of heavy drinking (>14 drinks per week for men or >7 for women) is similar (Table S4). Despite generally lower alcohol consumption among AIANs,[105] alcohol-attributable mortality is significantly higher than Whites,[106] in part reflecting less access to care.[107] In addition, binge and heavy drinking varies substantially by PRCDA region and is more common among AIANs in the Northern Plains, Pacific Coast, and East.[16]

Physical Activity

AIANs engage in similar levels of leisure-time physical activity as Whites (23% versus 22% no leisure-time physical activity, respectively), but are less likely to meet recommended levels of physical activity (52% versus 58%, respectively, Table S4). However, studies have shown that among Alaska Natives in particular, sedentary activity, such as hours spent watching TV, is lower than the general population.[108, 109] These studies have also shown that Alaska Natives spend more time engaging in low-intensity outdoor work, such as wild-food gathering,[110] which is protective against cancer and other chronic disease.

Infectious Agents

Helicobacter pylori

Chronic infection with *Helicobacter pylori (H. pylori)* is the primary cause of non-cardia gastric cancer.[84] Although the exact route of transmission is unknown, the bacteria probably spreads from person to person through bodily fluids or contaminated water or food.[111] In the US, infection is more likely among individuals with lower SES.[112] The majority of available research on *H. pylori* prevalence among AIANs has focused on Alaska Natives due to their especially elevated burden of gastric cancer.[85, 113] Household crowding, rurality, and use of non-municipal water sources, which are associated with *H. pylori*,[114] are more common in AIANs. Although national *H. pylori* prevalence is not available for the AIAN population, a study based on more than 500 Alaska Natives found a prevalence of about 75%,[114] in contrast to

Table S5. Cancer Screening Test Use (%), Vaccination Coverage (%), and Hepatitis Testing (%) by Race, US, 2017-2019

	AIAN	White
Cervical cancer screening, women* 25-65 years (NHIS 2015 & 2018)		
Pap test within past 3 years	77	84
Up-to-date†	84	86
Breast cancer screening (NHIS 2015 & 2018)		
Women 50 to 74 years		
Mammogram within past 2 years (USPSTF)	62	72
Mammogram within past year	46	56
Women ≥45 years		
Up-to-date‡	57	63
Colorectal cancer screening§ (NHIS 2015 & 2018)		
Ages ≥45 years		
Total	48	57
Men	52	58
Women	44	57
Ages ≥50 years		
Total	57	67
Men	60	68
Women	54	66
Ages 50-75 years (USPSTF)		
Total	56	69
Men	60	69
Women	55	68
HPV vaccine utilization, boys and girls 13-17 years (2019)		
≥1 dose	71	68
Up-to-date¶	58	52
Hepatitis B testing, ages ≥18 years (NHIS 2017)		
Has received hepatitis B test	32	30
Hepatitis C testing, ages 48-68 years (NHIS 2017)		
Has received hepatitis C test	21	18

AIAN: American Indian and Alaska Native; HPV: human papillomavirus; USPSTF: United States Preventive Services Task Force. All estimates are age adjusted. Data exclude persons of Hispanic ethnicity and are not confined to Purchased/Referred Care Delivery Area counties. *Among women with an intact uterus. †Pap test in the past 3 years among women 25-65 years OR Pap test and HPV test within the past 5 years among women 30-65 years. ‡Mammogram within the past year (ages 45-54 years) or past two years (ages ≥55 years). §For ages ≥45 and ≥50 years: fecal occult blood test (FOBT)/ fecal immunochemical test (FIT), sigmoidoscopy, colonoscopy, computed tomography (CT) colonography, OR sDNA test in the past 1, 5, 10, 5, and 3 years, respectively. For ages 50-75 years: FOBT/FIT, sigmoidoscopy, colonoscopy, CT colonography, OR sDNA test in the past 1, 5, 10, 5, and 3 years, respectively, OR sigmoidoscopy in past 10 years with FOBT/FIT in past 1 year. ¶Includes those with ≥3 doses, and those with 2 doses when the first HPV vaccine dose was initiated before age 15 years and there were at least five months minus four days between the first and second dose.

Sources: National Health Interview Survey (NHIS), 2015, 2017 and 2018. HPV: Elam-Evans LD, et al. *MMWR Morb Mortal Wkly Rep* 2020;69:1109-1116.

reported national prevalence of 27% for all races/ ethnicities combined.[115] Despite evidence of a high prevalence of infection in Alaska Natives, community-wide treatment is not recommended because reinfection rates and risk of antimicrobial resistance are high.[116-118] More research is needed to ascertain the costs and benefits of expanded treatment for gastric cancer prevention in high-risk populations.

Hepatitis B Virus and Hepatitis C Virus

Chronic infection with hepatitis B virus (HBV) or hepatitis C virus (HCV) increases risk of several cancers, most notably liver cancer.[119] AIANs have HBV infection prevalence similar to that in the general population, but the highest rates of HCV infection in the US, nearly triple that of any other racial group.[120] The US Department of Health and Human Services has designated AIANs as a priority population in its viral hepatitis action plan.[121] Antiviral therapy regimens can often clear established HCV infection and are associated with significantly improved outcomes,[122] including reduced liver cancer risk.[72] However, these drugs are expensive and unaffordable for many in the AIAN community). Further, many state Medicaid programs have restrictive requirements for HCV treatment, exacerbating disparities in liver cancer and other viral hepatitis-related liver disease.[123]

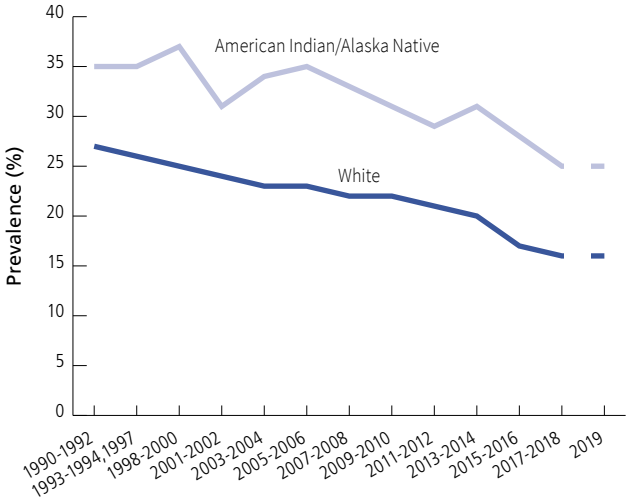
HPV

Nearly all cervical cancers are caused by persistent human papillomavirus (HPV) infection, as well as 90% of anal cancers, about 70% of oropharyngeal cancers, and 60%-70% of vaginal, vulvar, and penile cancers.[124, 125] Vaccines to prevent the most common oncogenic types of HPV have been available since 2006 and are recommended for boys and girls between 9 and 12 years of age, and for those ages 13 through 26 years as catch-up strategies. Receipt of the vaccination before the age of 17 in girls has been shown to lower the risk of invasive cervical cancer by 90%.[126] AIAN vaccination utilization among ages 13-17 years is higher than that of Whites (58% versus 52% in boys and girls combined, Table S5), but lower than the Healthy People 2020 goal of 80%.[127]

Cancer Screening in AIANs

In national survey data, AIANs are less likely than Whites to be up-to-date for breast (62% versus 72%, respectively), colorectal (56% versus 69%), and cervical cancer screening (84% versus 86%; Table S5). Screening rates are

Figure S7. Trends in Current Smoking by Race among Adults (Ages ≥18 Years), US, 1990-2019



All estimates are age adjusted. Data exclude persons of Hispanic ethnicity and are not confined to Purchased/Referred Care Delivery Area counties. Due to changes in survey design, 2019 estimates are not directly comparable to prior years and are separated from the trend line.

Source: National Health Interview Survey, 1990-1994, 1997-2019.

even lower for the 2.6 million AIANs who utilize the IHS, in part because these facilities often do not offer cancer screening.[42] For example, up-to-date cervical cancer screening in AIANs utilizing IHS facilities was 55% in 2017 (Table S6) versus 77% among AIAN women overall (Table S5). Further, the Purchased/Referred Care (PRC) program that covers health care services received at non-IHS facilities designates cancer screening as medical priority level II, meaning that these services can be denied when PRC funding is low.[55]

IHS screening rates vary considerably by region, ranging from a high of 70% for mammography in Oklahoma down to 30% for colorectal cancer in Phoenix (Table S6). Screening prevalence is generally lowest on the Pacific Coast (<50% for all cancers) and highest in Oklahoma and Alaska.

Access to colonoscopy for CRC screening is of particular importance for Alaska Natives due to their high risk for the disease and for *H. pylori*-associated hemorrhagic gastritis (see *H. pylori* section, page 40),[113, 128] which can cause false-positive fecal occult blood tests.[129] However, Alaska Natives face many challenges in obtaining colonoscopy services, most notably transportation barriers given that half of the population lives in areas that lack road networks. Since the late 1990s, the Alaska Native Tribal Health Consortium (ANTHC) has worked to improve access to endoscopy services by supporting colonoscopy field clinics in remote areas.[129] These efforts likely contribute in large part to Alaska achieving the highest screening rate (59%) of any IHS area (Table S6).

Improving screening access for rural AIAN populations is a crucial component of reducing cancer disparities. Overall, IHS facilities are located primarily in rural and isolated settings with little access to specialty services.[40] Innovative programs designed to improve screening in the Northern Plains, such as Minnesota's Intertribal Colorectal Cancer Council and the Wisdom Steps program, appear to have driven positive change and could be used as models in other tribal regions with a high colorectal cancer burden.[59] In addition, mobile mammography was used by the Great Plains IHS from 2005-2017 to reduce long travel times to screening mammography among American Indian women.[130-131] At the federal level, the CDC's National Breast and Cervical Cancer Early Detection Program partners with tribal groups to increase access to screening and diagnostic services for native women.

Summary and Opportunities to Alleviate AIAN Cancer Burden

AIAN men and women are vulnerable to cancer disparities due to long-standing inequalities in SES, education, and access to care. This population not only has a higher burden of major cancer risk factors (e.g., cigarette smoking, obesity, and cancer-causing infections) compared to Whites, but are also more likely to be diagnosed at a later stage and receive substandard treatment. Many of these disparities could be reduced by increasing access to high-quality cancer prevention, early detection, and treatment.

The IHS, the primary health care service for many AIANs, is underfunded and understaffed. IHS funding must be increased to an adequate level as a cornerstone of eliminating AIAN cancer disparities. However, as of fall 2021, the FY 2022 budget appropriations bill provides $7.61 billion for the IHS,[18] significantly less than the $12.8

Table S6. Cancer Screening Test Use (%) among American Indians and Alaska Natives by PRCDA Region and IHS Area, 2017

	All PRCDA	Alaska	East	Northern Plains			Southern Plains	Southwest				Pacific Coast	
		Alaska	Nashville	Billings	Great Plains	Bemidji	Oklahoma	Navajo	Phoenix	Tucson	Albuquerque	California	Portland
Cervical cancer screening, women 24-64 years*	55	65	60	46	46	53	63	58	49	52	65	49	49
Breast cancer screening, women 52-64 years†	55	59	63	50	50	55	70	55	45	49	60	49	46
Colorectal cancer screening, ages 50-75‡	41	59	50	34	33	48	52	41	30	34	43	38	42

PRCDA: Purchased/Referred Care Delivery Area; IHS: Indian Health Service. *Ages 24-64 with Pap test in the past 3 years or ages 30-64 years with Pap test and human papillomavirus DNA test within 5 years. †Mammography in previous 2 years. ‡Patients who have received appropriate colorectal cancer screening.

Source: Indian Health Service Data: FY 2017 GPRA/GPRAMA National and Area Results, Indian Health Service (IHS) GPRA Performance Results. https://www.ihs.gov/sites/crs/themes/responsive2017/display_objects/documents/gpra/FY_2017_GPRA_GPRAMA_NationalandAreaResults.pdf.

billion requested by tribal leaders and a mere 16% of the $48 billion that would be required to fully fund the organization.[17] In addition, the IHS falls outside the jurisdiction of the Affordable Care Act (ACA), which expanded access to care for low-income persons. However, Medicaid expansion through the ACA has the potential to increase insurance access for AIANs who would not otherwise qualify and are too poor to gain coverage through the ACA marketplace. As of September 2021, 25 of the 36 states with PRCDA counties had expanded Medicaid.[132]

Finally, AIANs are the only major racial/ethnic group for which high-quality cancer mortality data are not readily available to researchers through the National Center for Health Statistics (NCHS). As mortality data are the gold standard for measuring progress against cancer, linkage to IHS data should be standard practice in the creation of mortality databases for surveillance research. In particular, these data should be included in standard national reports that monitor progress against cancer by race and ethnicity, such as the Annual Report to the Nation on the Status of Cancer.

Additional Resources

The American Indian Cancer Foundation (AICAF)
https://www.americanindiancancer.org/

The American Indian Cancer Foundation (AICAF) is a national nonprofit organization that strives to reduce the burden of cancer in AIANs through community-based programs like Screen Our Circle, which aims to increase cancer screening and early detection rates in urban, native-serving clinics across the nation by raising awareness, promoting health system improvements, and facilitating education and outreach. The AICAF also provides culturally specific cancer survivorship resources to native communities.

Keep it Sacred National Native Network
https://keepitsacred.itcmi.org/

Keep it Sacred is a national network of tribes, tribal organizations, and tribal health programs that works to reduce tobacco use and cancer disparities among AIANs across the United States. The network disseminates informative resources to organizations that serve AIAN populations that are tailored to the unique cultural needs of AIANs. Keep it Sacred also provides assistance in implementing culturally competent interventions, policies, and cancer control systems for native populations.

Partnership for Native American Cancer Prevention (NACP)
https://nartc.fcm.arizona.edu/partnership-native-american-cancer-prevention-nacp

The Partnership for Native American Cancer Prevention is a collaboration between Northern Arizona University and the University of Arizona Cancer Center. Through research, education, and community outreach, the NACP seeks to reduce the cancer burden of AIANs living in the Southwestern US.

New Mexico Cancer Council (NMCC)
https://www.nmcancercouncil.org/

The New Mexico Cancer Council is a public/private collaboration that combats cancer in AIANs living in New Mexico through their New Mexico Cancer Plan, which includes measures such as increasing healthy behaviors, decreasing environmental exposures, and increasing recommended cancer screening test use.

Tribal Comprehensive Cancer Control (CCC) programs
https://www.cdc.gov/cancer/ncccp/ccc_plans.htm

Funded through the CDC, the Comprehensive Cancer Control programs address the cancer burden for a specific tribal group and provide culturally appropriate education, resources, and support to assist tribal health providers in preventing and treating cancer. Five-year plans are implemented utilizing strategies that have been successful for that specific tribe or in a similar area and are later evaluated at the end of the five years.

National Breast and Cervical Cancer Early Detection Program (NBCCEDP)
https://www.cdc.gov/cancer/nbccedp/index.htm

The National Breast and Cervical Cancer Early Detection Program is a CDC program that provides access to screening and diagnostic services for low-income, uninsured, and underserved women. The NBCCEDP has partnerships with 13 AIAN organizations and tribes, including the AICAF, Navajo, Hopi, and Cheyenne River Sioux. The list of available partnerships can be found here: https://www.cdc.gov/cancer/nbccedp/data/summaries/.

Colorectal Cancer Control Program (CRCCP)
https://www.cdc.gov/cancer/crccp/

The Colorectal Cancer Control Program awards health systems serving high-need populations with funding to improve access to evidence-based interventions that increase colorectal cancer screening. The program partners with the Alaska Native Tribal Health Consortium and the Inter-Tribal Council of Michigan.

Tribal Tobacco Control Programs

These programs seek to improve the health of AIANs through education on the importance of commercial tobacco use prevention, providing access to cessation tools, and promoting prevention policies while respecting the use of ceremonial tobacco.

Alaska Native Tribal Health Consortium (ANTHC) – Tobacco Prevention & Control
https://anthc.org/what-we-do/wellness/tobacco/

Black Hills Center for American Indian Health – Southwest Navajo Tobacco Education Prevention Project
https://www.bhcaih.org/sntepp

Northern Plains Tribal Tobacco Technical Assistance Center (NPTTTAC)
https://health.gptchb.org/nptttac/

Southeast Alaska Regional Health Consortium (SEARHC) – Freedom from Smoking – Smoking Cessation Program
https://searhc.org/freedom-smoking-smoking-cessation-program-2/

Nez Perce Tribe – Students for Success
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Cancer Disparities

Eliminating disparities in cancer is an overarching goal of the American Cancer Society. Cancer disparities occur when barriers to high-quality cancer prevention, early detection, and treatment create differences in cancer occurrence and outcomes based on sociodemographic factors such as race, ethnicity, age, income, sexual orientation, gender identity, or where you live. Most inequities in wealth, education, and overall standard of living among people of color stem from historical and persistent structural racism and discriminatory practices.[1] Inherited genetic factors contribute minimally to overall cancer disparities but do help explain some differences for certain high-risk groups. For example, women of Ashkenazi Jewish descent have higher breast cancer incidence because of a higher frequency of mutations in the breast cancer susceptibility genes *BRCA1* and *BRCA2*.[2]

Socioeconomic Status

Socioeconomic status (SES) is often measured in terms of income, education, and/or health insurance status for research purposes. Cancer death rates are higher among people with lower SES compared to people with higher SES, and this gap is widening.[3] For example, lung cancer mortality rates were 4.6 times higher among men with 12 or fewer years of education than among men with 4-year college degrees in 2016, up from 3 times higher in 2001.[4] This is largely due to a higher prevalence of cancer risk factors in people with lower SES. For example, smoking prevalence in 2019 was 27% among men without a high school education versus 6% among college graduates,[5] partly because of targeted marketing to people in low-income neighborhoods by tobacco companies. People with fewer resources also have less access to high-quality health care because of inadequate health insurance; fewer health care providers in low-income neighborhoods; financial, structural, and personal obstacles; low health literacy; and delays in the dissemination of advances in early detection and treatment to low-income areas.[1] People of lower SES are also more likely to live and work in areas with limited opportunities for physical activity and availability of fresh fruits and vegetables, alongside a higher risk of exposure to cancer-causing infections and harmful exposures, e.g. air pollutants due to closer proximity to vehicular traffic and other sources.[6,7] As a result, people of lower SES have a higher likelihood of developing cancer, often at a late stage of the disease; they are also less likely to receive the standard of care, and are more likely to have lower survival.[8]

Race/Ethnicity

Racial and ethnic disparities in the cancer burden largely reflect long-standing inequities in SES and access to high-quality health care, which can be attributed in large part to historical and persistent structural racism in the US experienced by all people of color. According to the US Census Bureau, in 2020, 20% of Black and 17% of Hispanic/Latino populations lived below the poverty line, compared to 8% of non-Hispanic White (White) and Asian populations. In addition, in 2019, 10% of Black and 19% of Hispanic/Latino populations were uninsured, compared to 6% of White and 7% of Asian populations. Even within SES groups, disparities by race and ethnicity persist as people of color are more likely to receive lower-quality health care than White people even when health insurance status, age, severity of disease, and health status are comparable.[9] Social inequalities, such as language barriers and provider bias, can likewise affect interactions between patients and physicians and contribute to miscommunication and receipt of substandard care.

Racial/ethnic variations also reflect cultural influences on cancer risk factor behaviors. For example, persons who are Hispanic or Asian have lower rates of lung cancer than other groups in Table 9 because these populations, as a whole, are historically less likely to smoke, although smoking behavior varies substantially within these broadly defined categories.[1] Conversely, because a relatively large proportion of persons who are Hispanic or Asian are recent immigrants, these populations generally have higher rates of cancer related to infectious agents (e.g., stomach), typically reflecting higher infection prevalence (e.g., *Helicobacter pylori*) in their native countries (Table 9).

Table 9. Incidence and Mortality Rates for Selected Cancers by Race and Ethnicity, US

Incidence, 2014-2018	All races/ ethnicities	Non-Hispanic White	Non-Hispanic Black	Asian/ Pacific Islander	American Indian/ Alaska Native†	Hispanic/ Latino
All sites	449.0	466.0	455.0	294.5	452.6	348.3
Male	487.9	501.3	529.2	295.3	477.3	370.2
Female	423.0	442.8	405.3	297.9	438.5	339.2
Breast (female)	126.9	132.5	127.1	98.8	110.5	96.3
Colon & rectum*	36.5	36.1	42.6	29.0	49.2	32.8
Male	42.1	41.5	50.4	34.4	55.8	39.2
Female	31.6	31.3	37.1	24.6	43.9	27.6
Kidney & renal pelvis	17.1	17.3	18.9	8.1	29.6	17.0
Male	23.2	23.5	26.1	11.3	39.0	22.3
Female	11.8	11.8	13.5	5.5	21.9	12.7
Liver & intrahepatic bile duct	8.6	7.2	10.9	12.4	18.1	13.8
Male	13.1	10.9	17.8	19.1	26.4	20.3
Female	4.7	3.9	5.5	7.1	11.1	8.1
Lung & bronchus	57.3	61.6	59.5	34.3	62.3	29.2
Male	65.8	69.0	77.4	42.5	68.5	36.1
Female	50.8	56.0	47.2	28.0	57.7	24.2
Prostate	106.4	99.9	172.6	55.0	79.8	85.3
Stomach	6.5	5.3	9.8	9.7	9.9	9.5
Male	8.7	7.4	13.3	12.6	12.8	12.0
Female	4.6	3.5	7.4	7.4	7.6	7.7
Uterine cervix	7.7	7.2	8.8	6.1	10.8	9.6
Mortality, 2015-2019						
All sites	152.4	157.2	178.6	96.4	161.4	109.7
Male	181.4	186.2	221.4	113.2	193.2	132.2
Female	131.1	135.4	152.1	84.2	138.1	93.9
Breast (female)	19.9	19.9	28.0	11.7	17.8	13.7
Colon & rectum	13.4	13.4	18.1	9.3	17.4	10.8
Male	16.0	15.8	22.7	11.1	21.3	13.7
Female	11.3	11.3	14.8	7.9	14.4	8.5
Kidney & renal pelvis	3.6	3.7	3.5	1.6	6.3	3.4
Male	5.2	5.4	5.3	2.4	9.4	4.9
Female	2.2	2.3	2.2	1.0	3.8	2.2
Liver & intrahepatic bile duct	6.6	5.9	8.5	8.6	12.2	9.3
Male	9.7	8.5	13.3	12.9	17.1	13.2
Female	4.1	3.6	4.8	5.3	8.3	6.0
Lung & bronchus	36.7	39.9	39.2	20.6	35.9	16.2
Male	44.5	47.0	54.0	26.9	42.3	22.1
Female	30.7	34.2	29.2	15.9	31.0	11.8
Prostate	18.9	17.8	37.9	8.6	21.0	15.6
Stomach	2.9	2.2	5.1	4.9	5.4	4.8
Male	3.9	3.0	7.5	6.2	7.2	6.1
Female	2.1	1.5	3.5	3.9	3.9	3.9
Uterine cervix	2.2	2.0	3.4	1.7	3.1	2.5

Rates are per 100,000 population and age adjusted to the 2000 US standard population and exclude data from Puerto Rico. All race groups are exclusive of Hispanic origin. *Colorectal cancer incidence rates exclude appendix. †Data are based on Purchased/Referred Care Delivery Area (PRCDA) counties and are not comparable to previous years due to the new exclusion of Hispanic ethnicity to improve accuracy. Mortality estimates for American Indians and Alaska Natives are underestimated because Indian Health Service-linked data are not publicly available.

Sources: Incidence – North American Association of Central Cancer Registries (NAACCR), 2021. Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2021.

Following is a brief overview of the cancer burden for three major racial and ethnic minority groups in the US. More detailed information for American Indian and Alaska Native people can be found in the Special Section beginning on page 30. Importantly, there is substantial variation within these diverse populations by country of origin, duration of residence in the US, geographic location, etc., a few examples of which are provided. In addition, cancer rates for some racial and ethnic groups are known to be underestimated due to misclassification

on medical and death records. All statistics for racial groups presented in this and subsequent sections are exclusive of Hispanic/Latino ethnicity.

Black people: Black men have the highest overall cancer mortality rate (221 per 100,000) than any other racial/ethnic group in the US, 19% higher than White men (186) and twice that of Asian and Pacific Islander men (113), who have the lowest rate (Table 9). Prostate cancer mortality among Black men is more than double that of men in every other group (Table 9). Black women have 41% higher breast cancer death rates than White women despite similar incidence rates (Table 9). Larger gaps in mortality compared to incidence reflect substantial disparities in survival for Black individuals (Table 7) due to disproportionate poverty because of systemic racism that reduces access to equitable care.[1] Recent research has shown that when treatment is equal, Black men have equivalent prostate cancer survival compared to White men.[10] See *Cancer Facts & Figures for African Americans/Black People*, available online at cancer.org/statistics for more information.

Asian and Pacific Islander (API) people: Cancer is the leading cause of death in the API population in the US.[11] Compared to other racial/ethnic groups, API men and women have the lowest overall cancer incidence and mortality, but have among the highest liver and stomach cancer rates, about double those in persons who are White (Table 9). Although lung cancer rates in the API population overall are about half those in White people, Native Hawaiian people have rates that surpass those of White people because of historically high smoking prevalence.[1] Large variations in cancer occurrence within the API population reflect diversity in terms of geographic origin, language, acculturation, and socioeconomic status. Unfortunately, contemporary cancer data are largely unavailable for individual API groups. See the *Cancer Facts & Figures 2016* Special Section on Cancer in Asian American, Native Hawaiians, and Pacific Islanders available online at cancer.org/statistics for more information.

American Indian and Alaska Native (AIAN) people: See page 30 for the Special Section on Cancer in American Indian and Alaska Native People.

Hispanic/Latino people: While cancer is the leading cause of death for Hispanic people, compared to White people, they have lower overall 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, compared to White people, those who are Hispanic have cervical cancer incidence rates that are about 30% higher, and liver and stomach cancer incidence rates that are about double (Table 9). However, rates vary substantially by country of origin, generation, birthplace, and duration of residence in the US due to acculturation and other factors.[12] For example, prostate cancer incidence is about 15% lower in Hispanic men overall than in White men (Table 9), but 44% higher in men residing in Puerto Rico, which is 99% Hispanic (Table 4). See *Cancer Facts & Figures for Hispanic/Latino People*, available online at cancer.org/statistics for more information.

For information about American Cancer Society efforts to reduce the cancer burden among historically excluded populations, see the Advocacy section on page 68.

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Tobacco Use

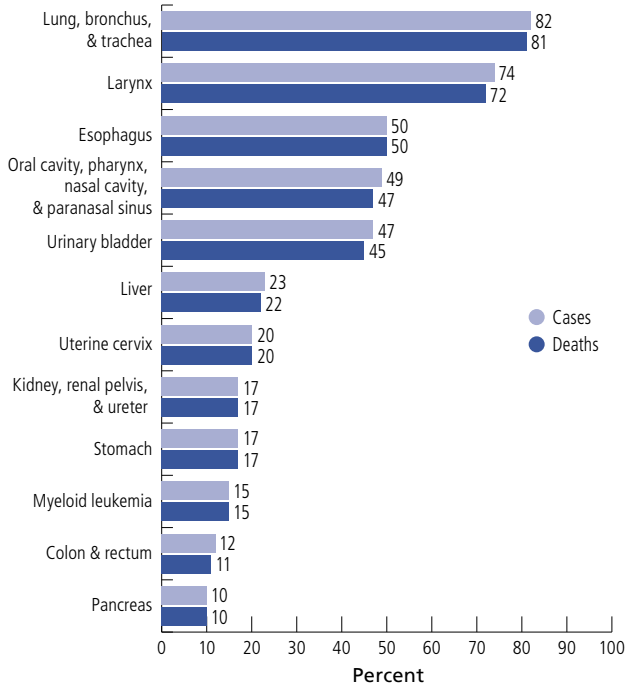
Tobacco use remains the most preventable cause of cancer occurrence and death in the US. Cigarette smoking still causes about 30% of all cancer deaths,[1,2] and as much as 40% in parts of the South and Appalachia, despite decades of decline.[3] More than 34 million adults in the US currently smoke cigarettes, with prevalence especially high in the South and among persons who are American Indian or Alaska Native (see Special Section, page 30); lesbian, gay, bisexual, or transgender; or who have low incomes or a history of mental illness.[4]

Cigarette Smoking

Cigarette smoking increases the risk of at least 12 cancers, including those of the oral cavity and pharynx, larynx, lung, esophagus, pancreas, uterine cervix, kidney, bladder, stomach, colorectum, and liver and acute myeloid leukemia (Figure 4).[5] Smoking may also increase the risk of fatal prostate cancer and a rare type of ovarian cancer.[5-7] Health consequences increase with both duration and intensity of smoking.

- The prevalence of current cigarette smoking among US adults ages 18 and older declined from 42% in 1965 to 14% in 2019, with the steepest drop among those ages 18-24 years (males: 54% to 8%, females: 38% to 8%).[8,9]
- In 2019, there continued to be wide variation in smoking prevalence by racial/ethnic group, ranging from 3% and 6% among Asian and Hispanic women, respectively, to 24% and 27% among American Indian/Alaska Native men and women, respectively.[9]
- Cigarette smoking prevalence remains high among those with low levels of education; for example, among adults 25 years of age and older, 23% of those with less than a high school diploma and 34% of those with a GED (General Educational Development) smoked in 2019, compared to 4% of those with graduate degrees.[9]
- At the state level, adult cigarette smoking prevalence in 2019 ranged from 8% in Utah to 25% in West Virginia.[10]
- Among US high school students, the prevalence of current cigarette smoking (past month) in 2020 was 5% (males 5%, females: 4%), down from 29% in 1999.[11,12]

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



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

Other Combustible Tobacco Products

In addition to cigarettes, other forms of combustible tobacco use include cigars, pipes, waterpipes (also known as hookahs or shishas), and roll-your-own products. Persons who smoke cigars regularly have an increased risk of cancers of the lung, oral cavity, larynx, and esophagus.[13-15] Although many users perceive waterpipe smoking to be less harmful than cigarettes, it delivers the same or higher levels of toxins,[16] and accumulating evidence suggests that it probably has the same adverse health effects as cigarettes.[17-19]

- Overall, 4% of adults in 2019 (men: 6%, women: 1%) reported currently smoking cigars.[9]
- In 2019, cigar smoking was more common among American Indian/Alaska Native (5%) and Black persons (5%) than White (4%), Hispanic (3%), or Asian (1%) persons.[9]
- Among high school students, 5% (of both girls and boys) had smoked cigars at least once in the past month in 2020.[11, 12]
- Cigar smoking is highest among Black students (9%) compared to White (4%) or Hispanic (6%) students.[12]
- In 2020, 3% of high school students reported waterpipe smoking in the past month.[12]

E-cigarettes

Electronic cigarettes, or e-cigarettes, are devices that aerosolize a liquid that typically contains nicotine, propylene glycol and/or vegetable glycerin, flavoring, and other ingredients. This aerosol is then inhaled by users. There is accumulating evidence that e-cigarette use causes short-term adverse effects on airways and blood vessels, but long-term risks are not yet known.[20-22] Potentially harmful substances include metals and other hazardous chemicals that can seep into the inhaled aerosol, as well as some flavoring components or additives. For example, e-cigarette, or vaping, product use-associated lung injury (EVALI), which caused more than 2,807 hospitalized cases or deaths as of February 2020,[23] has been attributed to exposure to vitamin E acetate, an additive in tetrahydrocannabinol (THC) containing e-cigarettes.[24] E-cigarettes are additionally concerning because they are addictive and may be a gateway to combustible tobacco among individuals who would otherwise have been nonsmokers; adolescents and young adults who use e-cigarettes are more likely than nonusers to begin using combustible tobacco products.[25-27] E-cigarette use is particularly concerning among youth because nicotine can impair adolescent brain development.[28]

No youth or young adults should begin using e-cigarettes. To date, no e-cigarette has been FDA-approved as a cessation aid, and e-cigarettes should not be used to quit smoking while it is not FDA-approved. Current e-cigarette users should not also smoke cigarettes or switch to smoking cigarettes, and former smokers now using e-cigarettes should not revert to smoking. Visit cancer.org/healthy/stay-away-from-tobacco/e-cigarette-position-statement.html for the American Cancer Society's position statement on e-cigarettes.

- About 5% of adults were current users of e-cigarettes in 2019, with prevalence higher in younger people (ages 18-24 years: 9%, 25-44 years: 6%) than older people (ages 65-74 years: 1%, ≥75 years: 0.2%).[9]
- The largest population increase in e-cigarette users from 2014 to 2018 was among adults ages 18-29 years who had never smoked cigarettes (from 0.5 to 1.4 million), suggesting a rise in primary nicotine initiation with e-cigarettes. E-cigarette use also increased significantly across all age groups among those who quit cigarette smoking recently (i.e., 1-8 years ago).[29]
- Current (past month) e-cigarette use among high school students skyrocketed from 1.5% in 2011 to 12% in 2017, 21% in 2018, and 28% (4.1 million users) in 2019, before declining to 20% (3 million users) in 2020.[12, 30, 31]
- In 2020, 23% of White high school students reported current e-cigarette use compared to 19% of Hispanic and 9% of Black students.[12]

Smokeless Tobacco Products

The major smokeless tobacco products marketed in the US are chewing tobacco and snuff, including snus (a "spitless," moist powder tobacco, often in a pouch). These products can cause oral, esophageal, and pancreatic cancers and are not a safe alternative to cigarettes.[32] Switching from combustible to spit tobacco has been shown to result in a higher risk of tobacco-related death than complete tobacco cessation.[33]

- In 2019, 5% of men and <1% of women were current (every day or some days) users of smokeless tobacco products;[9] use has remained stable since 2003.[34]
- Among US states and territories, adult smokeless tobacco use in 2018 ranged from 0.9% in Puerto Rico to 9% in Wyoming.[10]
- In 2019, 5% of high school boys and 1% of girls had used smokeless tobacco in the past month.[12]

Secondhand Smoke

Secondhand smoke (SHS) contains more than 7,000 chemicals, including hundreds that are toxic and at least 69 that can cause cancer.[5] There is no safe level of exposure to SHS. Nonsmokers who are exposed to SHS are at increased risk of lung cancer, other respiratory diseases, and heart disease.[35-38] In 2014, an estimated 5,840 nonsmoking adults in the US were diagnosed with lung cancer as a result of SHS exposure.[2] Comprehensive smoke-free laws are effective in reducing SHS exposure by modifying smoking behavior and reducing smoking-related disease.[37]

- Nationwide, SHS exposure (measured by testing a person's blood for cotinine, a byproduct of nicotine) among nonsmokers declined from 88% in 1988-1991 to 28% in 2009-2010; to 21% in 2017-2018, but remains substantially higher among Black (40%) persons than other racial/ethnic groups (Hispanic: 17%, White: 18%, Asian: 21%); exposure also decreases with increasing family income.[39]
- SHS exposure is highest among youth ages 3-17 years (35%), especially those who are Black (62%) versus White (34%), Hispanic (25%), or Asian (18%).[40]
- In 2015, nearly 1 in 5 (19%) nonsmoking workers reported exposure to workplace SHS in the past year and 10% reported frequent exposure, with the highest rates among younger individuals, men, and manual laborers.[41, 42]

Smoking Cessation

Smokers who quit increase their longevity regardless of age; however, those who quit by age 30 live an average of 10 years longer than if they had continued to smoke.[43, 44] Smoking cessation reduces the risk of at least 12 cancers, as well as heart disease and many other smoking-related diseases, and also improves outcomes for cancer survivors.[44] The 2020 US Surgeon General's report on smoking cessation noted historical improvements in several cessation indicators among US adults overall, but also found persistent disparities by sociodemographic, racial/ethnic, and geographic factors.[44]

- In 2019, 62% (55 million) of those who had ever smoked at least 100 cigarettes had quit (also known as "quit ratio"), up from 52% in 2009.[9, 45]
- However, the quit ratio in 2019 was <50% in persons who were American Indian or Alaska Native (49%), Black (47%), bisexual (49%), GED-educated (47%), at low income (42%), and uninsured or Medicaid insured (40%).[9]
- Although effective cessation treatments (i.e., counseling; FDA-approved nicotine replacement therapy or medications, such as Chantix [varenicline tartrate] or Zyban [bupropion hydrochloride]) can double or triple the likelihood of long-term abstinence, only about one-third of people who smoke used these aids in 2018-2019.[46]

Reducing Tobacco Use and Exposure

Numerous federal, state, and local tobacco control policies have been enacted since the release of the 1964 Surgeon General's Report on Smoking and Health,

including increasing cigarette taxes, improving access to cessation treatment, implementation of smoke-free workplace laws, improving health warnings, and restricting tobacco marketing.[5] These policies helped reduce smoking prevalence and averted almost 2 million smoking-related deaths through 2014.[47]

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 manufacture, sale, and marketing of tobacco products. Since then, the FDA has run highly successful mass media educational campaigns, including "The Real Cost" targeting youth and "Every Try Counts" targeting adult smokers. In April 2021, after substantial public health advocacy, including from our advocacy affiliate, the American Cancer Society Cancer Action Network[SM] (ACS CAN), the FDA announced its intention to ban menthol cigarettes and all flavored cigars given their role in promoting youth smoking initiation and hindering cessation.[48, 49] When in effect, this regulation has the potential for substantial public health benefits, especially among Black persons who have disproportionately high use of menthol and flavored products because of targeted advertising by the tobacco industry.[49] In December 2019, Congress raised the federal minimum age to purchase tobacco from 18 to 21 years, effective immediately. Additionally, provisions in the Affordable Care Act require most private and some public health insurance plans to provide at least minimum coverage of evidence-based cessation treatments (i.e., counseling, NRT, medications), although for many smokers, minimum coverage falls short of what is needed for long-term cessation.[44]

State initiatives have been on the forefront of effective tobacco control. Since 2000, all but two states – Missouri and North Dakota – have raised their cigarette taxes and more than 60% of the population is covered by a comprehensive smoke-free law.[50] The Centers for Disease Control and Prevention recommends best practices and funding levels for state tobacco control programs.[51] Unfortunately, for fiscal year 2021, the funding level for state tobacco prevention programs was less than 1% of the recommended level for four states (Connecticut, Georgia, Missouri, and Tennessee) and less than 50% of the recommended level for all states except Alaska, California, Hawaii, Delaware, Maine, North Dakota, Oklahoma, and Utah.[52]

Conclusion

Since the 1964 Surgeon General's report, smoking prevalence has declined by about two-thirds and millions of premature deaths have been averted. Nevertheless, more than 34 million people still smoke cigarettes, a disproportionate number of whom are low-income. Numerous studies confirm that comprehensive tobacco control, including higher taxes, 100% smoke-free environments, and sustained tobacco control program funding; comprehensive, barrier-free, and widely promoted coverage for tobacco cessation treatments; graphic warnings on cigarette packaging; and regulations to reduce the appeal and addictiveness of tobacco products can successfully reduce morbidity and economic disruption from tobacco use, and most importantly, save lives.

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

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Nutrition & Physical Activity

Aside from avoiding tobacco use, maintaining a healthy body weight, being physically active, consuming a healthful diet, and avoiding or limiting alcohol intake are the most effective strategies for reducing the risk of cancer. An estimated 18% of cancer cases and 16% of cancer deaths are attributable to the combined effects of excess body weight, alcohol consumption, physical inactivity, and an unhealthy diet.[1] In 2020, the American Cancer Society (ACS) released new diet and physical activity guidelines (summarized on page 58) for reducing cancer risk.[2] These guidelines include community action recommendations because of the strong influence of environment on individual diet and activity choices. Research has shown that adults who most closely followed prior ACS recommendations are 10%-20% less likely to be diagnosed with cancer and 25% less likely to die from the disease.[3]

Excess Body Weight

Excess body weight (i.e., overweight or obesity) is associated with an increased risk of developing several types of cancer: uterine corpus (endometrium), esophagus (adenocarcinoma), liver, stomach (cardia), kidney (renal cell), meningioma, multiple myeloma, pancreas, colorectum, gallbladder, ovary, female breast (postmenopausal), and thyroid.[4] There is some evidence that excess body weight may also increase the risk for cancers of the mouth, pharynx, larynx, and male breast, as well as fatal prostate cancer and non-Hodgkin lymphoma (diffuse large B-cell lymphoma).[5] An estimated 5% of cancers in men and 11% in women are attributed to excess body weight.[1]

Excess body weight influences risk for some cancers more strongly than for others. For example, 4% of ovarian cancer cases are attributed to excess body weight compared to 60% of uterine corpus (Figure 5).[1] Evidence is growing about the adverse health consequences of cumulative exposure to excess body fat over the life course as a result of excessive weight that begins during childhood.[6,7] However, emerging research suggests that even modest sustained weight loss can help mitigate breast cancer risk among women ages 50 and older who do not use hormone replacement therapy.[8]

2020 American Cancer Society Guideline on Diet and Physical Activity for Cancer Prevention[1]

Recommendations for individuals

1. Achieve and maintain a healthy body weight throughout life.

Keep body weight within the healthy range and avoid weight gain in adult life.

2. Be physically active.

Adults should engage in 150-300 minutes of moderate-intensity physical activity per week, or 75-150 minutes of vigorous-intensity physical activity, or an equivalent combination; achieving or exceeding the upper limit of 300 minutes is optimal.

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

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

3. Follow a healthy eating pattern at all ages.

A healthy eating pattern includes:

- Foods that are high in nutrients in amounts that help achieve and maintain a healthy body weight
- A variety of vegetables – dark green, red, and orange, fiber-rich legumes (beans and peas), and others
- Fruits, especially whole fruits with a variety of colors
- Whole grains

A healthy eating pattern limits or does not include:

- Red and processed meats
- Sugar-sweetened beverages
- Highly processed foods and refined grain products

4. It is best not to drink alcohol.

People who do choose to drink alcohol should limit their consumption to no more than 1 drink per day for women and 2 drinks per day for men.

Recommendation for community action

Public, private, and community organizations should work collaboratively at national, state, and local levels to develop, advocate for, and implement policy and environmental changes that increase access to affordable, nutritious foods; provide safe, enjoyable, and accessible opportunities for physical activity; and limit alcohol for all individuals.

For more information, visit:

Guidelines for cancer prevention: cancer.org/healthy/eat-healthy-get-active/acs-guidelines-nutrition-physical-activity-cancer-prevention/guidelines.html

Guidelines for cancer survivors: cancer.org/health-care-professionals/american-cancer-society-prevention-early-detection-guidelines/nupa-guidelines-for-cancer-survivors.html

- The prevalence of overweight (body mass index [BMI] – is defined as weight in kilograms divided by the square of height in meters – 25.0 to 29.9 kg/m^2) has remained relatively stable among US adults (ages 20-74 years) since the early 1960s at about 40% in men and 25%-30% in women.
- In contrast, obesity (BMI ≥30 kg/m^2) prevalence among adults has markedly increased from 11% of men and 16% of women from 1960-1962 to 43% of men and 42% of women in 2017-2018.[9, 10]
- In 2017-2018, obesity prevalence among men was highest in Hispanic persons (46%), followed by those who were White (45%), Black (41%), and Asian (18%); among women, obesity was highest among Black persons (57%), followed by those who were Hispanic (44%), White (40%), and Asian (17%).[11]
- Among youth (ages 2-19 years), overweight (BMI-for-age from 85th to <95th percentile) prevalence increased from 10% in the early 1970s to 16% in 2017-2018, whereas obesity (BMI-for-age ≥95th percentile) prevalence rose four-fold, from 5% in the early 1970s to 19% in 2017-2018.[10, 12]

- Between 1999-2000 and 2017-2018, obesity prevalence among adolescents (ages 12-19 years) increased in Mexican American (22% to 31%) and Black (21% to 28%) people but remained relatively stable in White people (14% to 16%).[13]
- In 2017-2018, 29% of children ages 2-5 years were overweight or obese compared to 37% of children ages 6-11 years and 38% of adolescents ages 12-19 years.[10]

Physical Activity

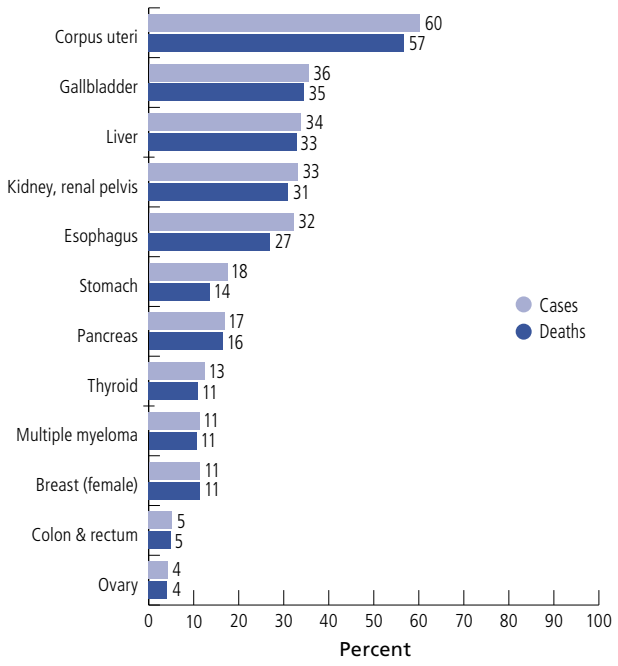
Physical activity decreases the risk of cancers of the colon (but not rectum), female breast, endometrium, kidney, bladder, esophagus (adenocarcinoma), and stomach (cardia), and possibly lung.[14-16] Approximately 3% of cancer cases are attributed to physical inactivity, although this is likely an underestimate because it is only based on colon, female breast, and endometrial cancers.[1] Cancer patients who are physically active are less likely to have adverse effects from treatment and to die from their cancer than those who are inactive.[17] Extended leisure-time sitting has also been associated with increased risk of cancer death,[18] whereas replacing sedentary time with even short durations of moderate to vigorous physical activity appears to reduce cancer mortality.[19]

- From 1998 to 2018, the proportion of adults who met recommended levels of aerobic activity increased from 40% to 54%.[20, 21]
- In 2018, 26% of adults reported no leisure-time physical activity (men: 23%, women: 28%), with a higher proportion of Black (34%) and Hispanic (34%) persons reporting physical inactivity than those who were White (22%) and Asian (21%).[21]
- In 2019, only 23% of US high school students (males: 31%, females: 15%) had engaged in at least 60 minutes of daily physical activity on all 7 days in the previous week, with lower levels among students who were Black (21%) and Hispanic (21%).[22]

Diet

Approximately 4%-5% of all cancer cases are attributed to poor diet.[1] Diet patterns high in red and processed meat, starchy foods, refined carbohydrates, and sugary drinks are associated with a higher risk of developing cancer (predominantly colon),[23] whereas those with an emphasis on a variety of fruits and vegetables, whole grains, legumes, fish or poultry, and fewer red and processed meats are associated with lower risk.[24, 25] One study found that individuals who have the healthiest diet have an 11%-24% lower risk of cancer death than those with the least healthy diet.[26] Moreover, cancer survivors who follow a healthy diet pattern have a 17%-18% lower risk of dying from cancer or other causes.[24]

Figure 5. Proportion of Cancer Cases and Deaths Attributable to Excess Body Weight in Adults 30 Years and Older, US, 2014



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

- Overall dietary patterns in US adults improved between 1999 and 2016, largely driven by increases in percent of energy intake from whole fruit, whole grains, nuts, and poultry, and declines in percent of energy intake from added sugars and fruit juice. However, these improvements were restricted to persons who were White, higher educated, and had medium or high incomes.[27]
- Among adults, across US states, a median of 27% reported eating two or more servings of fruit per day, and 13% reported consuming vegetables three or more times per day in 2019.[28]

- Between 1999 and 2018, total energy consumed from ultraprocessed foods among youth ages 2-19 years increased from 61% to 67%, with significantly larger increases in Black and Mexican American youth than among White youth.[29]

Alcohol

Alcohol consumption increases risk for cancers of the mouth, pharynx, larynx, esophagus (squamous cell carcinoma), liver, colorectum, female breast, and stomach.[5] An estimated 6% of cancer cases are attributed to alcohol consumption.[1] Cancer risk increases with alcohol volume, and even a few drinks per week may increase risk for some cancers. Alcohol consumption combined with tobacco use synergistically increases the risk of cancers of the mouth, pharynx, larynx, and esophagus far more than the additive effect of these exposures individually.[30]

- In 2018, 67% of adults reported current alcohol consumption (12+ drinks in lifetime and ≥1 drink in the past year).
- About 5% reported heavier drinking ([male] >14 drinks/week in the past year or [female] >7 drinks/week in the past year), ranging from 2% in Asian persons to 7% in White persons.[21]
- In 2019, 29% of US high school students reported current (past month) use of alcohol, with significantly higher levels among females (32%) compared to males (26%).[31]

Type 2 Diabetes

Type 2 diabetes, a chronic condition in which the body loses its ability to respond to insulin, shares several modifiable risk factors with cancer, including excess body weight, poor diet, and physical inactivity. Evidence also suggests that type 2 diabetes independently increases risk for several cancers, including liver, endometrium, pancreas, colorectum, kidney, bladder, breast, and perhaps ovary.[32-34] More than 90% of adults with diabetes have type 2 disease.[35]

- From 1999-2000 to 2017-2018, diabetes prevalence among adults ≥18 years of age increased from 10% to 14%.[36]
- In 2017-2018, the prevalence of diagnosed diabetes was higher among American Indian/Alaska Native (15%), Black (12%), and Hispanic (13%) persons than those who were Asian (9%) or White (8%), although rates varied by subpopulation (e.g., Asian Indian: 13%).[35]

Conclusion

Almost 1 in 5 cancers is caused by excess body weight, alcohol consumption, poor diet, and physical inactivity. Many Americans encounter substantial barriers to consuming a healthy diet and engaging in regular physical activity. To facilitate healthier lifestyles and curtail the future cancer burden, policy and environmental interventions across national, state, and local levels are needed. Efforts should include creative new strategies that are culturally appropriate and equitable to increase access to affordable, nutritious foods (e.g., healthy checkout aisles) and safe, enjoyable opportunities for physical activity (e.g., quality school physical education programs).[2]

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

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The Global Cancer Burden

The ultimate mission of the American Cancer Society is to lead the fight for a world without cancer. Cancer accounts for about 1 in every 6 deaths worldwide – second only to cardiovascular disease.[1] In 2020, there were an estimated 18.1 million new cancer cases and 9.9 million cancer deaths globally.[2] By 2040, the global burden is expected to reach 28.0 million new cancer cases and 16.2 million cancer deaths, solely due to the growth and aging of the population.[3] In low and medium Human Development Index Countries – many of which lack the medical resources and health systems to address the current disease burden – new cases are projected to increase by 95% and 64%, respectively. However, these projections may underestimate the future burden given the adoption of unhealthy behaviors and lifestyles associated with globalization and urbanization (e.g., smoking, poor diet, and physical inactivity) and changes in reproductive patterns (e.g., declining fertility rate, later age at first childbirth) in these countries.

Tobacco Use

Tobacco use is the largest avoidable cause of cancer mortality, responsible for about 1 in 4 cancer deaths worldwide – the equivalent of approximately 2.6 million cancer deaths in 2019.[4] Currently, only 19% of tobacco-attributable cancer deaths occur in low- and middle-income countries (LMICs), reflecting low historical smoking prevalence compared to higher-income countries. However, tobacco use has increased in many LMICs in recent years, foreshadowing a growing tobacco-related cancer burden. In 2019, residents of countries accounted for over 80% of the 1.1 billion current smokers worldwide ages 15 and over.[5] Further, more than 35% of individuals in upper middle-income countries smoked cigarettes in 2018, substantially higher than any other income group.[6]

In 2005, the World Health Organization's Framework Convention on Tobacco Control (FCTC), the world's first public health treaty, came into effect. Still, as of July 2021, several major tobacco-producing nations, including Argentina, Indonesia, and the United States, have not acceded to it. In 2020, about 69% of the world's population was covered by at least one significant comprehensive tobacco control measure at the highest level recommended by the FCTC, up from about 15% in 2008.[7] The WHO estimates that 23% of the world's population lives in complete smoke-free public and workplace environments and only 13% is covered by tobacco tax policy – the single-most effective intervention – that is at the prescribed level for optimal tobacco control. More encouragingly, 4.7 billion people (60% of the world's population) benefit from large graphic warnings on cigarette pack labels featuring all WHO-recommended characteristics.

Infection

Many cancers, such as cervical, liver, stomach, Kaposi sarcoma, and oropharyngeal, are caused by infectious agents. In 2018, an estimated 13% of all cancers worldwide (2.2 million) were attributable to infectious agents, ranging from less than 5% in the US to 50% in some countries in sub-Saharan Africa.[8] *Helicobacter pylori* (*H. pylori)*, human papillomavirus (HPV), hepatitis B virus (HBV), and hepatitis C virus (HCV) account for more than 90% of all infection-related cancers, with *H. pylori* and HPV accounting for more than two-thirds of cases globally. Most of these cancers are preventable through vaccination (HPV and HBV), screening (HPV), treatment (*H. pylori* and HCV), and behavioral changes. East Asia has the highest incidence because of population density, but sub-Saharan Africa has the highest proportion of cases attributable to infection by far (https://canceratlas.cancer.org/risk-factors/infection/).

Excess Body Weight

Excess body weight increases the risk of at least 13 cancer types and accounted for more than 4% of all cancer deaths among adults worldwide in 2019, ranging from an estimated 2.6% in low-income countries to 5.7% in high-income countries.[4, 9] The prevalence of excess body weight continues to increase rapidly across the globe, with approximately 40% of adults and 18% of children

overweight or obese in 2016.[10] Many LMICs have experienced the steepest increases due to changes in the food environment, such as increased availability of energy-dense, nutrient-poor foods, alongside reduced opportunities for physical activity. Globally, 28% of adults and 81% of adolescents were insufficiently physically active in 2016.[11]

The Role of the American Cancer Society

With more than a century of experience in cancer control, the American Cancer Society (ACS) is uniquely positioned to help save lives from cancer globally by assisting and empowering health professionals, health institutions, and cancer organizations in LMICs to implement evidence-based cancer control practices.

Develop civil society capacity in cancer control globally. Many LMICs lack a coordinated cancer control effort. The ACS Strengthening Organizations for a United Response to the Cancer Epidemic (SOURCE) Program aims to strengthen the civil society response to cancer across the continuum from prevention through end-of-life care in focus countries around the world. The program also facilitates the establishment of national cancer networks to coordinate the civil society response and elevate the voice of all organizations, big and small, in the cancer fight.

Increase HPV vaccination worldwide. The Global HPV Cancer Free initiative works to normalize HPV vaccination as cancer prevention in LMICs. The initiative envisions all clinicians recommending the vaccine routinely and confidently to age-appropriate adolescents; parents demanding and consenting for their adolescents to be vaccinated; community influencers advocating for its access and uptake; and policymakers mandating and funding the vaccine in national and sub-national programs. Currently engaged in Kenya, Colombia, and India, the initiative is seeding multicomponent action led by in-country cancer organizations to increase the uptake of HPV vaccination among clinicians and parents through behavioral interventions that are experimentally tested for effectiveness and engineered for scale-up through health systems and communities.

Improve global patient support. Through the ACS Building Expertise, Advocacy, and Capacity for Oncology Navigation (BEACON) Initiative, we support health institutions and cancer organizations in LMICs to design, implement, and sustain cancer patient navigation programs to remove barriers to care. ACS has created a dynamic and self-service global patient navigation toolkit supported by a peer learning collaborative to help stakeholders interested in providing more patient-centered care build and deliver programs suited to their local context utilizing available resources. The toolkit also provides resources to facilitate the delivery of high-quality cancer education for patients, caregivers, and their families. The toolkit and peer learning collaborative pilot launch is scheduled for February 2022.

Make effective treatment available to all in need. The ACS Global Cancer Treatment team works to reduce cancer mortality by addressing disparities in access to affordable, high-quality treatment. Along with collaborators such as the National Comprehensive Cancer Network, the Clinton Health Access Initiative (CHAI), and the African Cancer Coalition, ACS has developed more than 45 cancer treatment guidelines adapted for use in sub-Saharan Africa and covering more than 88% of people with cancer in the region. ACS and CHAI have brokered agreements with four pharmaceutical companies to reduce the cost of 26 lifesaving cancer treatments by an expected 60%. Additionally, the ChemoSafe project supports African Health Ministries and cancer treatment centers to improve the safe handling and administration of chemotherapy through the implementation of safety standards, training, and access to personal protective equipment.

More than 3.2 billion people worldwide lack access to adequate pain relief. Improved access to essential pain medicines is arguably the easiest and least expensive unmet need to improve cancer care in LMICs. ACS leads projects to improve access to essential pain medicines and supports national morphine production programs that have dramatically reduced cost and increased access. The Pain-Free Hospital Initiative is a one-year hospital-wide quality improvement initiative designed to integrate pain treatment into service delivery by

providing education, raising motivation and awareness, documenting pain levels, improving medicine supply, and communicating impact. The initiative has been implemented in more than 75 hospitals and has trained 25,000 health workers, resulting in a reduction of more than 50% in patient-reported pain scores.

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The American Cancer Society

The American Cancer Society (ACS) 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 discourse through education campaigns, working to inform both health practitioners and the public about the disease.

More than 100 years later, ACS is still leading the fight for a world without cancer by funding and conducting research, sharing expert information, supporting patients, and working to reduce long-standing disparities in cancer prevention, diagnosis, and treatment. In addition, our advocacy affiliate, the American Cancer Society Cancer Action Network℠ (ACS CAN), actively pursues evidence-based public policies at the local, state, and federal levels that seek to reduce cancer suffering, death, and disparities for all individuals, regardless of race, ethnicity, gender, age, sexual orientation, socioeconomic status, or ZIP code. (For more information on these initiatives, see the Advocacy section on page 68.)

This work could not be accomplished without the strength of our dedicated volunteers to drive every part of our mission. With the support of our professional staff, volunteers raise funds to support innovative research, provide rides to treatment for people with cancer, and offer peer-to-peer support to those facing a cancer diagnosis – and that's just the beginning. Thanks in part to our contributions, 3.2 million cancer deaths have been averted in the US since 1991, when cancer death rates were at their peak.

Cancer Prevention and Early Detection

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

Prevention

Tobacco use remains the most preventable cause of cancer death. Cigarette smoking increases the risk of at least 12 different cancers, with 30% of all cancer deaths in the US, including about 80% of lung cancer deaths, attributed to smoking. The American Cancer Society continues our long history of work to reduce tobacco use through research (see page 70), education, and advocacy (see page 68). Our tobacco control efforts focus on the adoption and implementation of smoke- and tobacco-free policies in all workplaces, public places, and other important venues such as multiunit residential settings. In addition, we're taking steps to reduce tobacco-related health disparities, including among the disproportionately high percentage of smokers who also have mental health or substance use disorders. We are also addressing the evolving tobacco product marketplace and rapid increase in the use of electronic tobacco products, or e-cigarettes, by youth.

Aside from avoiding tobacco use, maintaining a healthy, active lifestyle is one of the most effective ways to reduce cancer risk. The American Cancer Society regularly performs a formal review of the current scientific evidence on diet and cancer and synthesizes it into clear, informative recommendations for the general public to promote healthy individual behaviors and environments that support healthy eating and active living to reduce cancer risk. These diet and physical activity guidelines were updated in 2020 and form the foundation for our communication, worksite, school, and community strategies designed to encourage and support people in making healthy choices.

Skin cancer is the most commonly diagnosed cancer in the US, with more than 5 million new cases annually. For this reason, the American Cancer Society promotes skin cancer prevention in educational messages throughout the year and joined with other members of the National Council on Skin Cancer Prevention to designate the Friday before Memorial Day as Don't Fry Day.

We also provide guidelines for human papillomavirus (HPV) vaccination and established the National HPV Vaccination Roundtable, which is working with health care professionals nationwide to increase vaccination in adolescents to eliminate cervical cancer and reduce incidence of other HPV-associated cancers. Through our Vaccinate Adolescents against Cancers (VACs) program, we have implemented interventions in structured HPV vaccination in 138 federally qualified health care centers and 13 integrated delivery systems and trained over 15,000 providers on HPV vaccination as cancer prevention. Clinics have seen an average HPV series initiation rate increase of 12.8% over the course of our year-long intervention projects.

The challenges of engaging in health behaviors that reduce cancer risk are compounded for people with lower incomes, people of color, persons with disabilities, and those living in rural communities. Structural and social inequities (e.g., racism, classism, ableism) shape the factors that influence a person's health, including health-related behaviors and non-medical social and physical environmental factors, such as access to healthy, affordable food, transportation, and the financial means to pay for medications, housing, utilities, and other services.

To address these obstacles, we work with community health centers and other health systems, corporate partners, policymakers, volunteers, and other stakeholders across the nation to advance health equity by increasing access to preventive care. Programmatic efforts include health equity pilots in 10 communities to address food insecurity through community-driven solutions; collaborating with Pfizer to reduce the breast cancer mortality disparity between Black and White women in nine communities; and partnering with the National Football League (NFL) to support Community Health Advocates implementing Nationwide Grants for Empowerment and Equity (CHANGE) in safety-net health systems across the country to increase cancer screening and improve timely follow-up care. Overall, the CHANGE program has contributed to more than 1 million breast, cervical, and colorectal cancer screenings in underserved communities since 2011.

Early Detection

Finding cancer at its earliest stage, when it might be easier to treat, gives patients the greatest chance of survival. Moreover, screening tests for cervical and colorectal cancer can detect precancers, allowing for cancer prevention. To help health care providers and the public make informed decisions about cancer screening, the American Cancer Society publishes early detection guidelines based on the most current scientific evidence for cancers of the breast, cervix, colorectum, endometrium, lung, and prostate. In addition, we have a history of implementing campaigns among the public and with health care professionals to increase awareness of the value of screening. For example, campaigns to increase the use of Pap testing and mammography have contributed to more than a 70% decrease in cervical cancer mortality since 1969 and a 42% decline in breast cancer mortality since 1989. In 2019, the American Cancer Society and the National Colorectal Cancer Roundtable (NCCRT) built on the success of an earlier initiative and launched an effort to increase colorectal cancer screening prevalence among adults ages 50 and older to 80% in every community. In the past five years, more than 1,750 organizations have committed to working toward this shared goal.

Workplace Initiatives

Cancer is the leading cause of premature death in the US working-age population (ages 20-65 years). Therefore, the American Cancer Society is working with business leaders across the country to establish a workplace culture of health. Through the American Cancer Society Health Index for Employers™, we work with companies to implement evidence-based solutions to improve health outcomes across the cancer continuum. This initiative focuses on five domains across the cancer continuum:

1. Tobacco prevention and cessation
2. Healthy eating
3. Physical activity
4. Cancer screening and prevention
5. Cancer support

Features of the initiative include:

- Annual organization-level assessment that measures the health and well-being of the workplace across the five domains
- A score report with tailored recommendations to improve workplace health and well-being policies, programs, benefit structures, and communication practices
- A suite of evidence-based solutions to help employers make improvements to their current health and well-being initiatives
- National benchmark report and recognition program based on achievement

Patient and Caregiver Services

The American Cancer Society provides resources that can help improve – and even save – lives to people with cancer and their caregivers. Our 24/7 cancer helpline offers one-on-one support through phone calls, live chats, and video chats with trained cancer information specialists. Through our Reach To Recovery® program, the American Cancer Society offers support for people newly diagnosed with breast cancer. We also work to support those facing cancer who cannot drive themselves to treatment, as well as those who must travel far from home for treatment, through our transportation and lodging programs.

Cancer Information

Trained American Cancer Society staff are available 24/7 through our cancer helpline at 1-800-237-2345 to connect people with answers about a cancer diagnosis, health insurance assistance, ACS programs and services, print materials, and referrals to other services. Our website, cancer.org, offers easy-to understand, evidence-based, and accurate cancer information. People with cancer and their caregivers can find detailed and reliable information about 70+ types of cancer, available treatments, managing side effects, and living as a cancer survivor. Visitors to cancer.org will also find news and survivor stories, as well as what's happening in cancer

research. We also help people living in the US who speak languages other than English find the assistance they need at cancer.org/cancer-information-in-other-languages.

The American Cancer Society also publishes books to help people navigate the cancer experience. Visit cancer.org/bookstore to learn more. In addition, ACS publishes three peer-reviewed scientific journals for health care professionals and researchers: *Cancer*, *Cancer Cytopathology*, and *CA: A Cancer Journal for Clinicians*. Visit cancer.org/health-care-professionals/acs-publications.html to learn more about these journals.

Programs and Services

Survivorship: American Cancer Society survivorship work aims to help people living with and moving beyond cancer from diagnosis through long-term survivorship to the end of life. Efforts focus on helping survivors manage their ongoing physical, psychosocial, and functional problems and engage in healthy behaviors to optimize their wellness. Our post-treatment survivorship care guidelines are designed to promote survivor health and quality of life by facilitating the delivery of high-quality, comprehensive, coordinated clinical follow-up care. Our survivorship research efforts focus on understanding the impact of cancer on survivors' lives and on developing and testing interventions to help survivors actively engage in their health care and improve their health and well-being through and beyond treatment. Resources on cancer.org include an information guide to help cancer survivors and their caregivers understand various aspects of the survivorship journey. The guide also includes trusted resources for survivorship information and encourages communication with health care professionals. We also offer an informational video series developed specifically for caregivers. With funding support from the Centers for Disease Control and Prevention, ACS has also a virtual training for health care providers on effective communication techniques for discussing behavioral changes around nutrition, physical activity, and obesity risk with cancer survivors.

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

Transportation to treatment: When transportation to treatment is a concern, the American Cancer Society may be able to help provide the rides. Thanks to volunteer drivers, our Road To Recovery® program offers free rides to people who would otherwise have difficulty getting to their cancer-related appointments.

Lodging during treatment: The American Cancer Society Hope Lodge® program provides a free home away from home for people facing cancer and their caregivers. More than just a roof over their heads, it's a nurturing community that helps people access the care they need. In 2019, more than 30 Hope Lodge locations provided over 500,000 nights of free lodging for more than 29,000 people with cancer and their caregivers – saving them more than $50 million in hotel expenses. Because of the temporary pause in services due to the COVID-19 pandemic, these figures represent the most recent full year of data available.

Breast cancer support: The American Cancer Society Reach To Recovery® program connects people facing breast cancer – from diagnosis through survivorship – with trained volunteers who are breast cancer survivors. Volunteers provide one-on-one support to help those facing breast cancer cope with their diagnosis, treatments, side effects, and more. Through our website (reach.cancer.org) and mobile app, people facing breast cancer can create an online profile and match with a volunteer who has experienced a similar type of breast cancer, stage, and treatment.

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

Finding hope and inspiration: The American Cancer Society Cancer Survivors Network® provides a safe online community where cancer survivors and caregivers share their stories, ask questions, and get support from each other. At csn.cancer.org, members can participate on discussion boards or join chat rooms and build their own support network from among the members.

Advocacy

Saving lives from cancer is as much a matter of public policy as scientific discovery. Lawmakers play a critical role in enacting policies that help save lives – from quality, affordable health care for all to increasing funding for cancer research and programs. 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 policymakers to achieve these goals and make cancer a top priority for public officials through a lens of health equity. ACS CAN also empowers advocates across the country to make their voices heard and influence evidence-based public policy change, as well as legislative and regulatory solutions, that will reduce the cancer burden.

Created in 2001, ACS CAN is the nation's leading voice advocating for public policies that help to defeat cancer. ACS CAN has successfully worked to pass and implement laws at all levels of government that assure cancer patients' access to adequate and affordable health insurance coverage; increase funding for groundbreaking cancer research; improve access to prevention and early detection measures, treatment, and follow-up care; and improve quality of life for cancer patients and survivors.

ACS CAN's recent advocacy accomplishments 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 July 2021 and do not take into account any potential changes to health care being considered by Congress, the administration, or the courts.

Access to Care

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

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

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

- Ensuring expansion of the Medicaid program, which provides much-needed health services to lower-income individuals

Research Funding and Drug Development

ACS CAN is a leader in the effort to ensure full funding for the nation's public cancer research institutions, including the National Institutes of Health and its National Cancer Institute (NCI). Thanks in no small part to ACS CAN's work, Congress has steadily increased funding for NCI over the past several years. Today, the NCI has a budget of more than $6.5 billion, most of which is awarded through grants to researchers in cancer centers, universities, and labs in every state of the country. Federal budget pressures threaten this funding every year, and ACS CAN recognizes this driver of the research pipeline to be of prime importance in the search for cures and in efforts not only to protect this funding, but also to expand it.

In addition to advocating for cancer research funding, the organization works to enhance cancer patients' access to innovative therapies by improving clinical trial enrollment. Clinical trials are the key step in advancing potential new cancer treatments from the research setting to the cancer clinic, and patient participation in trials is crucial to their success. Approximately 20% of cancer clinical trials fail because of insufficient patient enrollment, despite a strong willingness on the part of patients to participate. To address this problem, ACS CAN, in collaboration with other stakeholders, has identified several barriers and is working on implementing a set of consensus recommendations to make it easier for patients to enroll in an appropriate clinical trial. ACS CAN also works to ensure that traditionally underrepresented patient populations have an equal opportunity to enroll in clinical trials through efforts to expand eligibility screening and advocate for legislation that would make it easier for trial sponsors to pay for non-medical patient costs related to participating in a clinical trial (e.g., parking, transportation, or lodging).

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 and prohibition of flavors in all tobacco products
- Leading efforts to pass comprehensive smoke-free laws requiring all workplaces, restaurants, and bars to be smoke-free, such as an ordinance in Shreveport, Louisiana, that went into effect on August 1, 2021, making all bars and casinos smoke-free
- 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 $1.91 per pack (as of July 2021).
- Working to increase and protect state funding for tobacco control programs, such as the $2 per pack cigarette tax increase that Oregon voters overwhelmingly approved in 2020, with some of the new revenue dedicated to the state tobacco control program. As a result, Oregon more than doubled its state funding for tobacco control to $24 million for fiscal year 2022.
- 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
- Addressing systemic racism in the enforcement of commercial tobacco control laws by advocating for implementation to be entrusted with public health or other non-police officers
- Advocating for coverage of cancer screenings and other recommended preventive services without financial barriers in private insurance, Medicare, and Medicaid, including federal legislation to create a pathway for Medicare to consider covering new cancer early detection blood tests once they are FDA approved

- Advocating for full funding for the National Breast and Cervical Cancer Early Detection Program, which provides lower-income, uninsured, and medically underserved women access to cancer screenings, as well as diagnostic, patient navigation, and treatment services
- Urging policymakers to invest federal and state funds in colorectal cancer control programs and eliminate out-of-pocket costs for colonoscopy following a positive stool test
- Supporting efforts to help increase HPV vaccination uptake
- Advocating for evidence-based child nutrition programs

Quality of Life

ACS CAN supports balanced pain policies at the federal and state levels that ensure continued patient and survivor access to pain treatments. The organization also supports the enactment of legislation to ensure that cancer patients have full access to palliative care services, along with curative treatment, from the point of diagnosis through treatment and survivorship or end of life as needed. The legislation provides for increased training and professional development in palliative care, a nationwide public and provider education campaign to disseminate information about the benefits of palliative care, and additional research on pain and symptom management with the intent of improving patient care.

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

Research

Research is at the heart of the American Cancer Society's mission. We have invested more than $5 billion in research since 1946, all to find the causes of cancer, ways to detect the disease earlier, more effective treatments, and ways to help people thrive during and after treatment. ACS is unique among nongovernmental, nonprofit organizations in having both intramural and extramural research programs, both of which will turn 76 years old in 2022. The top-tier research we fund and conduct covers everything from cell biology and immunology to nutrition to genetics to environmental and behavioral factors to inequalities in cancer occurrence and outcomes. Research at the American Cancer Society is currently organized under three departments: Extramural Discovery Science, Population Science, and Surveillance and Health Equity Science, which are described below.

Extramural Discovery Science

The American Cancer Society's extramural research program supports a portfolio of highly innovative cancer research at top US academic research institutions. Since 1946, we have awarded more than 33,700 grants to academic research institutions across the US supporting over 25,000 investigators and made critical contributions to many of the most important discoveries in cancer. In 2019, William Kaelin, MD, from Dana Farber Cancer Institute and Gregg Semenza, MD, PhD, from Johns Hopkins School of Medicine were the latest additions to the list of 49 ACS grantees who have gone on to win the Nobel Prize. Current ACS grantees publish over 1,200 scientific papers annually, detailing their discoveries across a wide range of cancers using a multitude of scientific approaches.

Extramural Discovery Science has three research programs – Biochemistry and Immunology of Cancer; Cell Biology and Preclinical Cancer Research; and Clinical and Cancer Control Research. The primary strategic goal for ACS-funded extramural research is to support innovation in cancer research, regardless of cancer type. Time and again, scientific history teaches us that the application of novel discoveries occurs in unexpected places, and thus we believe that a focus on

innovation gives us the greatest chance to make advances to benefit cancer patients. Except for professorships, all grant applications must align with at least one of the six ACS research priority areas: etiology or causes of cancer; obesity/healthy eating and active living; diagnosis and screening; and treatment, survivorship, and health equity across the continuum.

All extramurally funded projects are subjected to a rigorous, independent, and highly competitive two-stage peer review, with the primary review conducted by one of 12 peer review committees:

- DNA Mechanisms in Cancer
- RNA Mechanisms in Cancer
- Tumor Biology and Endocrinology
- Immunology and Blood Cell Development
- Mission Boost Grants
- Cancer Cell Biology
- Metastasis and Microenvironment
- Cancer Detection and Progression
- Experimental Therapeutics
- Cancer Prevention, Screening, and Health Promotion
- Cancer Treatment, Palliative Care, and Survivorship
- Health Outcomes, Policy, and Systems Research

The Council for Extramural Research is responsible for setting the paylines across the entire program. This independent and nationally competitive process ensures that the most innovative research is funded.

Beginning in the late 1990s, Extramural Discovery Science began to focus on early-stage investigators who in 2021 continue to have a difficult time launching their cancer research programs. Today, about 70% of the budget is committed to these scientists, giving the best and brightest minds in cancer research an opportunity to explore highly innovative ideas as they begin their careers in hopes that this early investment will pay dividends for decades to come.

The following competitive grants are offered by the American Cancer Society for extramural support:

- **Research Scholar Grant (RSG)** – provides resources for investigator-initiated research projects in a variety of cancer-relevant areas. Applicants are independent, self-directed researchers within eight to 10 years (depending on clinical service) of their first academic appointment.
- **Postdoctoral Fellowship (PF)** – funds mentored training for a career in cancer research
- **Clinician Scientist Development Grant (CSDG)** – supports protected time to allow junior faculty who see patients to be mentored and participate in research training
- **Institutional Research Grant (IRG)** – awards seed money to institutions for new investigators to initiate cancer research projects
- **Mission Boost Grant (MBG)** – provides opportunities for ACS grantees to seek additional ("boost") resources for innovative high-risk/high-reward projects nearing patient testing
- **Pilot and Exploratory Project (PEP)** – supports research studies to explore novel areas of research in palliative care of cancer patients
- **TheoryLab™ Collaborative Grants (TLC)** – pilot grant for collaborative research through participation in ACS TheoryLab to explore high-risk ideas
- **American Cancer Society Professor (RP & CRP)** – provides flexible funding for individuals who have made seminal contributions that have changed, and will continue to change, the direction of cancer

In addition, to amplify its impact, the Extramural Discovery Science department has partnered with several other organizations, including the Emerson Collective, Flatiron Health, the National Palliative Care Research Center, the Melanoma Research Alliance (MRA), and the St. Baldrick's Foundation.

The Extramural Discovery Science department houses three scientific research portfolios that support innovative cancer research to meet critical needs in cancer:

A. Biochemistry and Immunology of Cancer

- Molecules involved in cancer
- Genes involved in cancer
- Potential targets for new treatments of cancer and mechanisms of signal transduction
- Immunology of cancer including immunotherapy

B. Cell Biology and Preclinical Cancer Research

- Fundamental controls that dictate cancer cell development and regulation of cell growth
- Mechanisms driving cancer progression
- Cancer biomarker discovery and development
- Discovery, synthesis, and delivery of cancer drugs

C. Clinical and Cancer Control Research

- Clinical research to test novel interventions, methods to prevent, detect, treat, or survive cancer
- Innovative methods to sustain behavioral change
- Access to care and palliative care research
- Health equity research to uncover root causes of inequities based on the social determinants of health and testing strategies to achieve health equity

As of August 1, 2021, the American Cancer Society was funding a portfolio of 630 research grants totaling more than $384 million, including $71.4 million for breast cancer (153 grants), $27.2 million for lung cancer (74 grants), and $26.2 million for colorectal cancer (67 grants). In addition, extramural funding supports studies of some of the most lethal cancers, including pancreas ($12.4 million), brain ($9.3 million), ovarian ($10.9 million), and liver ($10.5 million). Since many cancers share biological characteristics, a significant portion of the funding portfolio is focused on these pan-cancer studies ($92.8 million), which investigate topics such as common cellular differences across cancer type that can result in simultaneous advances against multiple cancers.

To encourage greater collaboration among ACS grantees, the Extramural Discovery Science department launched the TheoryLab™ online platform in 2018 to enable and encourage greater collaboration among ACS grantees. There are currently more than 1,400 members representing a wide range of cancer research.

Population Science

The Population Science program has two primary focus areas; a long-standing epidemiology program that increases knowledge of factors associated with cancer occurrence and survivorship, and more recent initiatives in behavioral interventions research. Contributions from Population Science ultimately inform our evidence-based programs and recommendations, which are focused on enhancing cancer prevention, improving outcomes, and reducing disparities.

The epidemiology work began in 1952, when biologist and epidemiologist E. Cuyler Hammond engaged the American Cancer Society's nationwide network of volunteers to initiate a large cohort of study participants to provide insights into the causes of cancer. The first cohort, the Hammond-Horn Study (followed from 1952 to 1955), included only men and provided the first US prospective evidence confirming the association between cigarette smoking and premature death from lung cancer and other diseases. This work established the foundation for a series of subsequent, large cohort studies of men and women called the Cancer Prevention Studies (CPS). For nearly 70 years, results from these studies have contributed extensively to the science on cancer risk associated with modifiable and non-modifiable factors, and they have informed the American Cancer Society's and international guidelines for cancer prevention.

Today, Population Science staff focus their efforts on questions that leverage the strength of existing resources to address the following broad research objectives:

- **Epidemiology of modifiable risk factors:** Fill in gaps in knowledge about factors related to cancer etiology, survival, and long-term survivorship, including genetics; modifiable risk factors such as smoking,

physical and sedentary activity, diet, alcohol, and excess body weight; medical conditions and common medications; and environmental exposures (e.g., circadian rhythm disruption, radon, pollutants).

- **Molecular epidemiology:** Improve understanding of the molecular epidemiology of cancer, with a focus on breast, gastrointestinal, hematologic, ovary, and prostate cancers, through studies of circulating biomarkers; genetic factors and gene-environmental interactions; and tumor heterogeneity.
- **Survivorship and quality of life:** Identify factors associated with optimal physical, emotional, and social well-being among cancer patients, survivors, and caregivers to improve their quality of life; assist American Cancer Society program staff in the design and enhancement of interventions and services for cancer survivors and their loved ones.
- **Health behaviors:** Identify behaviors and related predictors associated with cancer prevention, with a primary focus on tobacco control, healthy eating, and active living, as well as their effects on cancer survivors' psychological adjustment and quality of life, in order enhance the efficacy of behavioral interventions and inform American Cancer Society programs, practices, and policies.
- **Cancer disparities and health equity:** Develop approaches and methods for cancer disparities/health equity research, examine exposures and outcomes in medically vulnerable populations, and identify effective strategies to help eliminate cancer disparities from prevention to survivorship.

Surveillance and Health Equity Science

The Surveillance and Health Equity Science (SHES) department informs and promotes cancer prevention and control via five overlapping areas: Surveillance Research; Risk Factor & Screening Research; Health Services Research; Disparities Research; and Tobacco Control Research. Information is disseminated via peer-reviewed journal articles for scientific audiences and educational publications for a lay audience. For example, the program has produced this *Cancer Facts & Figures* report annually since 1951, and its accompanying Cancer Statistics article, published in *CA: A Cancer Journal for Clinicians*, since 1967. These publications are the most widely cited sources for cancer statistics in the scientific literature and are available on our website at cancer.org/statistics. An accompanying mobile-friendly interactive website, the Cancer Statistics Center, is available for generating customized data at cancerstatisticscenter.cancer.org.

Since 1998, SHES staff have collaborated with leading cancer organizations, such as the National Cancer Institute and Centers for Disease Control and Prevention, to produce the Annual Report to the Nation on the Status of Cancer, a highly cited, peer-reviewed journal article that reports cancer rates and trends in the US. International products available in multiple languages include *The Cancer Atlas* (canceratlas.cancer.org), a one-stop resource for global cancer data, and *The Tobacco Atlas* (tobaccoatlas.org), a comprehensive guide to tobacco control that receives tens of thousands of visitors each month from nearly every country in the world.

With an overarching goal of reducing health inequalities, staff in the SHES department also generate scientific evidence to inform and support ACS priority areas for cancer prevention and control. For example, a series of high-profile studies conducted by our Surveillance Research group demonstrating increasing rates of colorectal cancer in individuals under 55 years of age informed the ACS colorectal cancer screening guideline update in 2018, which lowered the recommended age to begin screening from 50 to 45, and led the way for the same change to the USPSTF screening guideline in 2021. Researchers also study barriers to receipt of screening and provide data to guide roundtable activities, such as evaluating the impact of the COVID-19 pandemic on screening test use.

SHES staff also study public policies such as excise tax on tobacco products (including e-cigarettes) and tobacco industry activities on tobacco consumption to inform or support advocacy for tobacco control policies at the federal, state, and local levels. Further, the department

evaluates policies associated with access to and receipt of guideline-recommended care, economic burden, and health outcomes. For example, findings from the Health Services Research group have been instrumental in understanding the effects of health insurance coverage and provisions of the Affordable Care Act (ACA) on cancer care and outcomes. A recent study found that newly diagnosed cancer patients living in states that had expanded Medicaid eligibility were more likely to be diagnosed with early-stage disease than those living in non-expansion states.

Sources of Statistics

Estimated new cancer cases. The number of invasive cancer cases diagnosed in 2022 was calculated by estimating complete case counts during 2004 through 2018 in all 50 states and the District of Columbia (DC) using a spatiotemporal model that considers state variation in sociodemographic and lifestyle factors, medical settings, and cancer screening behaviors, and also accounts for expected delays in case reporting. Input data for the model was cancer occurrence information from cancer registries that consented to participate and met the North American Association of Central Cancer Registries' (NAACCR) high-quality data standards. The NAACCR is an umbrella organization that sets standards and collects and disseminates incidence data from cancer registries in the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) program and/or the Centers for Disease Control and Prevention's National Program of Cancer Registries. Modeled counts are then projected forward 4 years based on the most recent 4-year average annual percent change (AAPC) in cases. For more information on this method, see "A" and "B" under Additional information on page 75.

The numbers of new cases in 2022 of melanoma in situ and ductal carcinoma in situ of the female breast were estimated by first approximating the actual number of cases diagnosed each year during 2009 through 2018 by applying annual age-specific incidence rates to the corresponding population estimates and then projecting 4 years ahead based on the overall AAPC. These projections were adjusted for delays in case reporting based on established delay factors for invasive cancer and thus may be underestimates.

Incidence rates. Incidence rates are defined as the number of people who are diagnosed with cancer divided by the number of people who are at risk for the disease in the population during a given time period. Incidence rates in this publication are presented per 100,000 people and are age-adjusted to the 2000 US standard population to allow comparisons across populations with different age distributions. State-specific incidence rates were previously published in the NAACCR's publication *Cancer Incidence in North America, 2014-2018*. (See "C" under Additional information on page 76 for full reference.) National rates presented herein may differ slightly from those previously published by the NAACCR for several reasons. First, national rates in this publication exclude Puerto Rico, which is presented separately. In addition, beginning with *Cancer Facts & Figures 2022*, rates for American Indian or Alaska Native (AIAN) people and Asian or Pacific Islander (API) people now exclude persons of Hispanic ethnicity to improve their accuracy. Finally, colorectal cancer incidence rates presented herein exclude cancers of the appendix.

Trends in cancer incidence rates provided in the Selected Cancers sections of this publication are based on delay-adjusted incidence rates from the 21 SEER registries. Delay adjustment accounts for delays and error corrections that occur in the reporting of cancer cases, which is substantial for some sites, particularly those less often diagnosed in a hospital, such as leukemia. Delay adjustment is not available for some cancer types. These trends were originally published in the SEER Explorer. (See "D" under Additional information on page 76 for full reference.)

Stage distribution. The proportion of cancer cases diagnosed at a local, regional, or distant stage (as well as in situ for urinary bladder) was based on the 2014-2018 NAACCR data described above for incidence rates.

Estimated cancer deaths. The number of cancer deaths in the US in 2022 was estimated by fitting the observed number of cancer deaths from 2005 to 2019 to the same log-linear regression model used to produce estimated cases and then similarly using the most recent 4-year AAPC to forecast the number of deaths expected in 2022. 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 "B" under Additional information on page 75.)

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, presented per 100,000 people and 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 2019.

Important note about estimated cancer cases and deaths for the current year. The methodologies for predicting cancer cases and deaths in the current year were recently re-evaluated and updated. 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 and methodology. As such, they are not informative for tracking cancer trends. Because finalized incidence and mortality data for 2020 are not yet available, estimates also do not reflect the impact of COVID-19 on cancer diagnoses and deaths. 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 relative survival rates, which is a measure of life expectancy among cancer patients compared to that among the general population of the same age, race/ethnicity, and sex. Survival rates herein are based on data from the National Cancer Institute's SEER registries for individuals diagnosed from 2011 through 2017 for 5-year survival and 2003 through 2017 for 10-year survival, with all patients followed through 2018. Contemporary survival rates for White and Black individuals are exclusive of Hispanic ethnicity. All rates were generated using SEER*Stat software version 8.3.9. (See "E" under Additional information on page 76 for full reference.)

Probability of developing cancer. Probabilities of developing cancer were calculated using DevCan (Probability of Developing Cancer) software version 6.7.9, developed by the NCI, and are based on all 21 SEER registries. (See "F" under Additional information on page 76 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 in 16 men 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. Lui B, Zhu L, Zou J, et al. Updated methodology for projecting US and state-level cancer counts for the current calendar year: Part I: Spatiotemporal small area modeling for cancer incidence. *Cancer Epidemiol Biomarkers Prev*. 2021; published online June 22.

B. Miller KD, Siegel RL, Lui B, et al. Updated methodology for projecting US and state-level cancer counts for the current calendar year: Part II: Evaluation of temporal projection methods for incidence and mortality. *Cancer Epidemiol Biomarkers Prev*. 2021; published online August 17.

C. Sherman R, Firth R, Charlton M, et al. (eds). Cancer in North America: 2014-2018. Volume Two: Registry-specific Cancer Incidence in the United States and Canada. Springfield, IL: North American Association of Central Cancer Registries, Inc. June 2021. Available at https://www.naaccr.org/wp-content/uploads/2021/06/CiNA.2014-2018.v2.incidence-2.pdf.

D. SEER*Explorer: An interactive website for SEER cancer statistics [Internet]. Surveillance Research Program, National Cancer Institute. [Cited 2021 April 15]. Available from https://seer.cancer.gov/explorer/.

E. Surveillance, Epidemiology, and End Results (SEER) Program (seer.cancer.gov) SEER*Stat Database: Incidence – SEER Research Data, 18 Registries, Nov 2020 Sub (2000-2018) – Linked To County Attributes – Time Dependent (1990-2018) Income/Rurality, 1969-2019 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2021, based on the November 2020 submission.

F. DevCan: Probability of Developing or Dying of Cancer Software, Version 6.7.9; Statistical Research and Applications Branch, National Cancer Institute, 2021. https://surveillance.cancer.gov/devcan/.

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

Cancer Site	Population	Test or Procedure	Recommendation
Breast	Women, ages 40-54	Mammography	Women should have the opportunity to begin annual screening between the ages of 40 and 44. Women should undergo regular screening mammography starting at age 45. Women ages 45 to 54 should be screened annually.
	Women, ages 55+		Transition to biennial screening, or have the opportunity to continue annual screening. Continue screening as long as overall health is good and life expectancy is 10+ years.
Cervix	Women, ages 25-65	HPV DNA test, **OR** Pap test & HPV DNA test	**Preferred:** Primary HPV test alone every 5 years with an FDA-approved test for primary HPV screening. **Acceptable:** Co-testing (HPV test and Pap test) every 5 years or Pap test alone every 3 years.
	Women, ages >65		Discontinue screening if results from regular screening in the past 10 years were negative, with the most recent test within the past 5 years.
	Women who have been vaccinated against HPV		Follow age-specific screening recommendations (same as unvaccinated individuals).
	Women who have had a total hysterectomy		Individuals without a cervix and without a history of cervical cancer or a history of CIN2 or a more severe diagnosis in the past 25 years should not be screened.
Colorectal†	Men and women, ages 45+	Guaiac-based fecal occult blood test (gFOBT) with at least 50% sensitivity or fecal immunochemical test (FIT) with at least 50% sensitivity, **OR**	Annual testing of spontaneously passed stool specimens. Single stool testing during a clinician office visit is not recommended, nor are "throw in the toilet bowl" tests. In comparison with guaiac-based tests for the detection of occult blood, immunochemical tests are more patient-friendly and are likely to be equal or better in sensitivity and specificity. There is no justification for repeating FOBT in response to an initial positive finding.
		Multi-target stool DNA test, **OR**	Every 3 years
		Flexible sigmoidoscopy (FSIG), **OR**	Every 5 years alone, or consideration can be given to combining FSIG performed every 5 years with a highly sensitive gFOBT or FIT performed annually
		Colonoscopy, **OR**	Every 10 years
		CT Colonography	Every 5 years
Endometrial	Women at menopause		Women should be informed about risks and symptoms of endometrial cancer and encouraged to report unexpected bleeding to a physician.
Lung	Current or former smokers ages 50-80 in fairly good health with 20+ pack-year history	Low-dose helical CT (LDCT)	The American Cancer Society is currently reviewing the new scientific evidence for lung cancer screening. In the interim we recommend following the updated guidelines from the US Preventive Services Task Force (uspreventiveservicestaskforce.org/uspstf/recommendation/lung-cancer-screening), which recommends annual LDCT screening in adults ages 50-80 who have a 20-pack year smoking history and currently smoke or have quite within the past 15 years.
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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