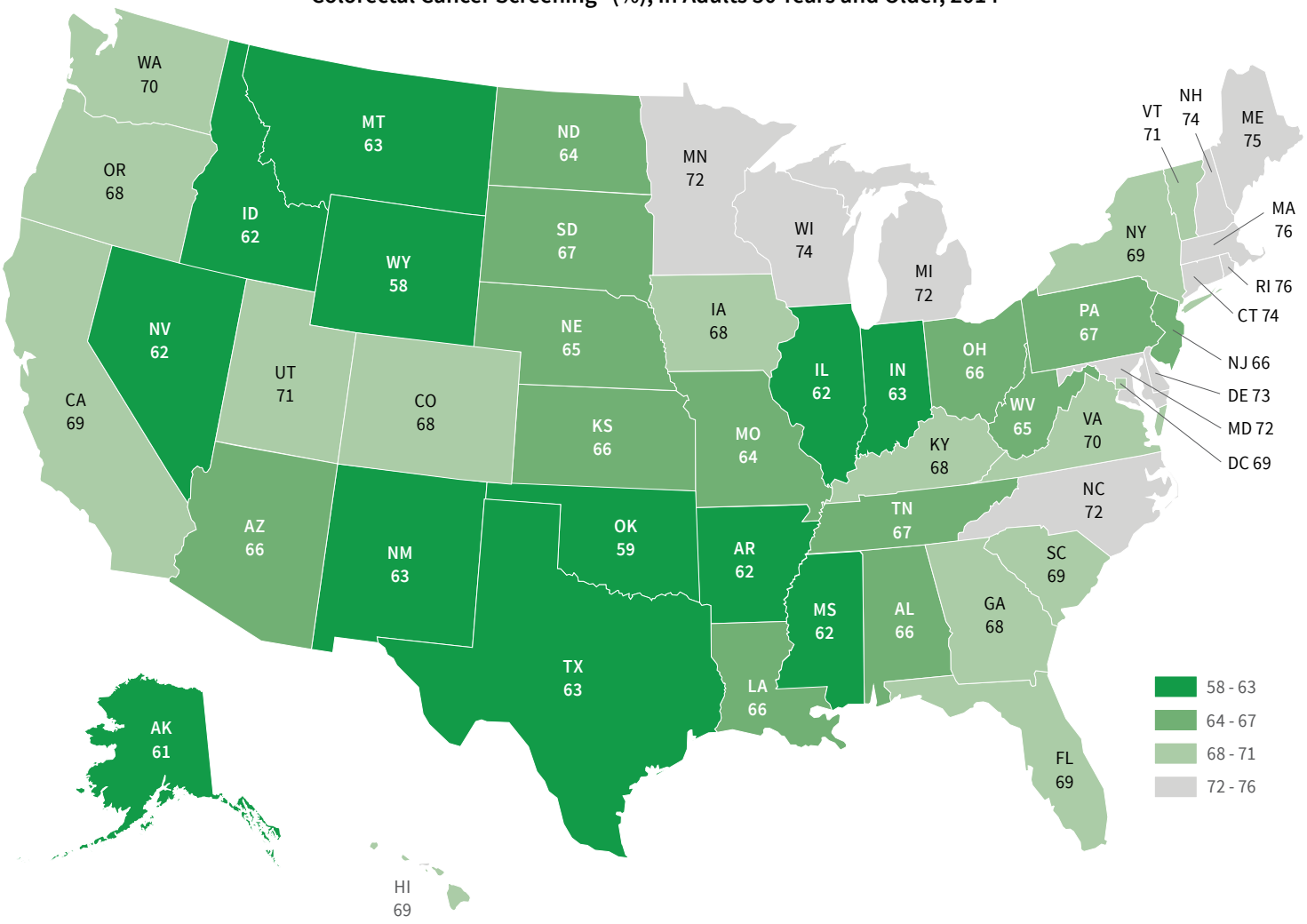
Colorectal Cancer
Facts & Figures 2017-2019

Colorectal Cancer Screening* (%), in Adults 50 Years and Older, 2014



*A fecal occult blood test within the past year, or sigmoidoscopy within the past five years or colonoscopy within the past 10 years.
Note: The colorectal cancer screening prevalence estimates do not distinguish between examinations for screening and diagnosis.

Source: Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System, 2014. Public use data file.

Contents

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

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

Colorectal Cancer Basic Facts

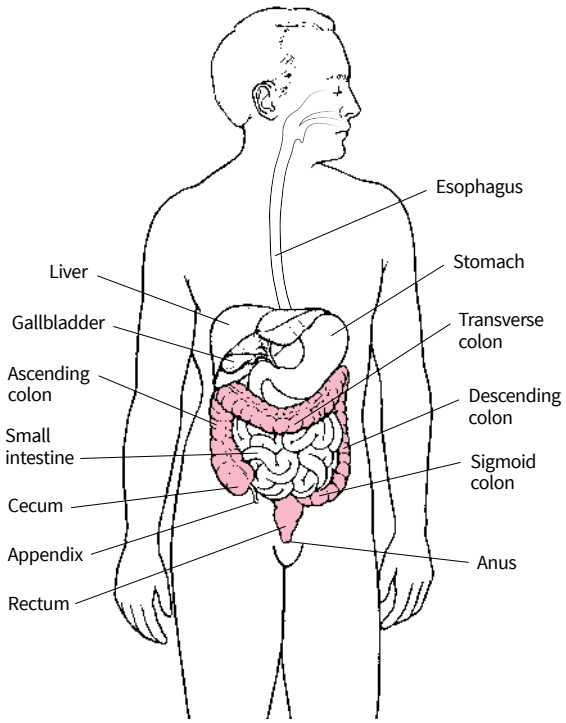
What is colorectal cancer?

Cancer is a disease characterized by the unchecked division and survival of abnormal cells. When this type of abnormal growth occurs in the colon or rectum, it is called colorectal cancer (CRC). The colon and rectum (colorectum), which combined are referred to as the large intestine, are the final part of the gastrointestinal (GI) system, which processes food for energy and rids the body of solid waste (fecal matter or stool) (Figure 1). After food is chewed and swallowed, it travels through the esophagus to the stomach. There it is partially broken down and sent to the small intestine, where digestion continues and most of the nutrients are absorbed. The small intestine joins the large intestine in the lower right abdomen. The small and large intestine are sometimes called the small and large bowel, which is why CRC is sometimes referred to as bowel cancer. The first part of the large intestine is the colon, a muscular tube about 1.5 meters (5 feet) long and 5 centimeters (2 inches) in diameter. The colon has 4 sections:

- The *ascending colon* begins with the cecum (a pouch where undigested food is received from the small intestine) and extends upward on the right side of the abdomen.
- The *transverse colon* is so-called because it crosses the body from the right to the left side. The ascending and transverse colon are collectively referred to as the proximal colon.
- The *descending colon* descends on the left side.
- The *sigmoid colon*, which is named for its "S" shape, is the final portion of the colon and joins the rectum. The descending and sigmoid colon are collectively referred to as the distal colon.

Water and nutrients are absorbed from food matter as it travels through the colon. Waste from this process passes from the sigmoid colon into the rectum – the final 15 centimeters (6 inches) of the large intestine – and is then expelled through the anus. Despite their anatomic proximity, cancers in the anus are classified separately from those in the colorectum because they originate from different cell types, and thus have different characteristics. Within the colorectum, there are also distinct differences in biology based on anatomic location, which are reflected in the tumors that develop.[1] For example, tumors in the proximal colon are much more common in older than in younger patients and in women than in men; these patients have lower survival rates than patients with tumors in the distal colon or rectum.[2, 3]

Figure 1. Anatomy of the Gastrointestinal System



How does colorectal cancer start?

CRC usually begins as a noncancerous growth called a polyp that develops on the inner lining of the colon or rectum and grows slowly, over a period of 10 to 20 years.[4, 5] An adenomatous polyp, or adenoma, is the most common type. Adenomas arise from glandular cells, which produce mucus to lubricate the colorectum. About one-third to one-half of all individuals will eventually develop one or more adenomas.[6, 7] Although all adenomas have the potential to become cancerous, fewer than 10% are

estimated to progress to invasive cancer.[8,9] The likelihood that an adenoma will become cancerous increases as it becomes larger.[10] Cancer arising from the inner lining of the colorectum is called adenocarcinoma and accounts for approximately 96% of all CRCs.[11]

Once cancer forms in the inner lining of the large intestine, it can grow into the wall of the colon or rectum (Figure 2). Cancer that has grown into the wall can also penetrate blood or lymph vessels, which are thin channels that carry away cellular waste and fluid. Cancer cells typically spread first into nearby lymph nodes, which are bean-shaped structures that help fight infections. Cancer cells can also be carried in blood vessels to other organs and tissues, such as the liver, lungs, or peritoneum (membrane lining the abdomen). The spread of cancer cells to parts of the body distant from where the tumor originated is called metastasis.

What are the stages of colorectal cancer?

The extent to which cancer has spread at the time of diagnosis is described as its stage. Staging is essential for determining treatment choices and assessing prognosis (prediction of disease outcome). The two most common cancer staging systems are the TNM system, typically used in clinical settings, and the Surveillance, Epidemiology, and End Results (SEER) summary staging system, used for descriptive and statistical analysis of tumor registry data. In this document, we will describe CRC stages using the SEER summary staging system:

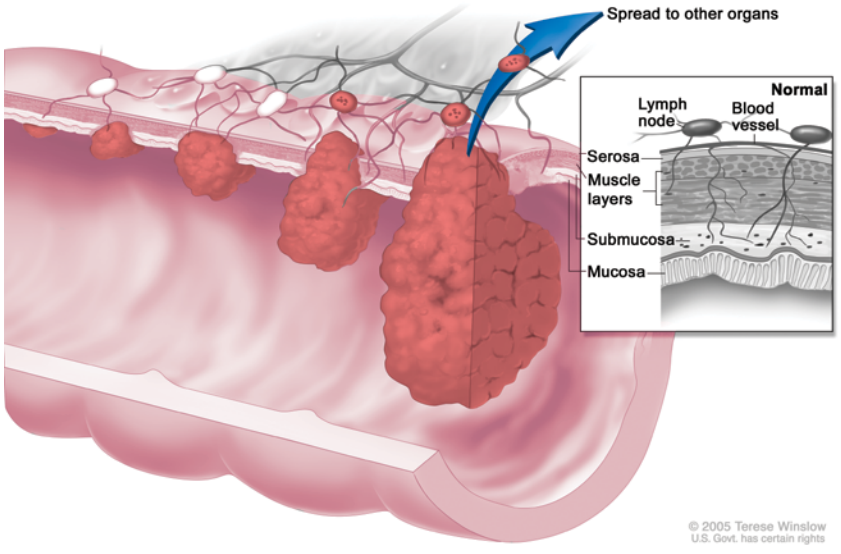
- **In situ:** Cancers that have not yet begun to invade the wall of the colon or rectum; these preinvasive lesions are not included in the cancer statistics provided in this report.
- **Local:** Cancers that have grown into the wall of the colon or rectum, but have not extended through the wall to invade nearby tissues
- **Regional:** Cancers that have spread through the wall of the colon or rectum and have invaded nearby tissue, or that have spread to nearby lymph nodes
- **Distant:** Cancers that have spread to other parts of the body, such as the liver or lung

What are the symptoms of colorectal cancer?

Early CRC often has no symptoms, which is why screening is so important. As a tumor grows, it may bleed or obstruct the intestine. In some cases, blood loss from the cancer leads to anemia (low number of red blood cells), causing symptoms such as weakness, excessive fatigue, and sometimes shortness of breath. Additional warning signs include:

- Bleeding from the rectum
- Blood in the stool or in the toilet after having a bowel movement
- Dark or black stools
- A change in bowel habits or the shape of the stool (e.g., more narrow than usual)
- Cramping or discomfort in the lower abdomen
- An urge to have a bowel movement when the bowel is empty

Figure 2. Colorectal Cancer Growth



- Constipation or diarrhea that lasts for more than a few days
- Decreased appetite
- Unintentional weight loss

Timely evaluation of symptoms consistent with CRC is essential. This is true even for adults younger than age 50, among whom CRC incidence is rare, but increasing, and for whom screening is not recommended for those at average risk.

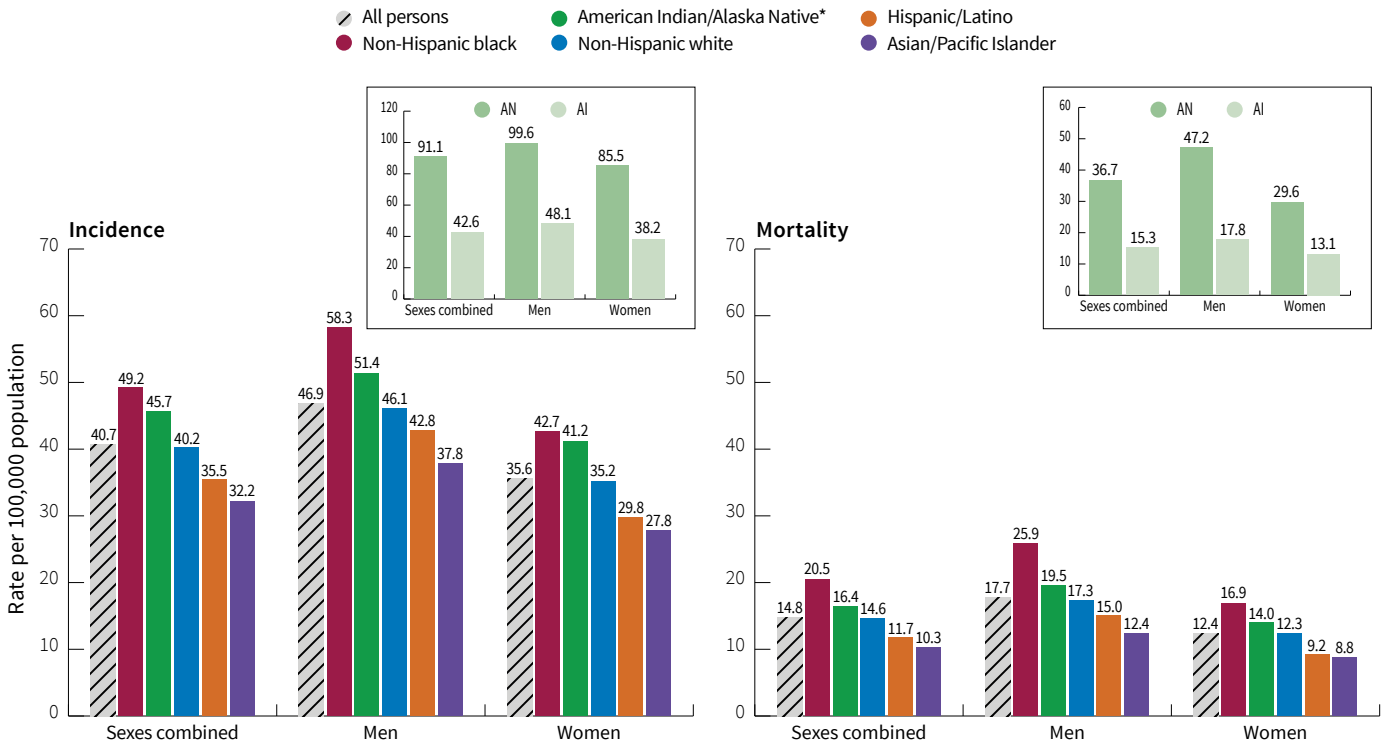
Colorectal Cancer Occurrence

How many new cases and deaths are estimated to occur in 2017?

In 2017, there will be an estimated 95,520 new cases of colon cancer and 39,910 cases of rectal cancer diagnosed in the US.[12] While the numbers for colon cancer are fairly equal in men (47,700) and women (47,820), a larger number of men (23,720) than women (16,190) will be diagnosed with rectal cancer.

An estimated 27,150 men and 23,110 women will die from CRC in 2017. Unfortunately, reliable statistics on deaths from colon and rectal cancers separately are not available because almost 40% of deaths from rectal cancer are misclassified as colon cancer on death certificates.[13] The high level of misclassification is partly attributed to confusion between the terms colon cancer and colorectal cancer because of widespread use of "colon cancer" to refer to both colon and rectal cancers in educational messaging.

Figure 3. Colorectal Cancer Incidence (2009-2013) and Mortality (2010-2014) Rates by Race/Ethnicity and Sex, US



AN: Alaska Native; AI: American Indian, excluding Alaska. Rates are age-adjusted to the 2000 US standard population. *Statistics based on data from Contract Health Service Delivery Area (CHSDA) counties; incidence rates exclude data from Kansas.

Sources: Incidence – North American Association of Central Cancer Registries (NAACCR), 2016; Alaska Natives only – Surveillance, Epidemiology, and End Results (SEER) Program, 2016. Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2016.

How many people who have been diagnosed with colorectal cancer are alive today?

As of January 1, 2016, there were 724,690 men and 727,350 women alive in the US with a history of CRC.[14] Some of these people were cancer-free, while others still had evidence of cancer and may have been undergoing treatment.

What is the risk of developing colorectal cancer?

Approximately 4.6% of men (1 in 22) and 4.2% of women (1 in 24) will be diagnosed with CRC in their lifetime.[12] Lifetime risk is similar in men and women despite higher incidence rates in men because women have longer life expectancy. Some of the factors that influence risk are:

Age

The risk of CRC increases with age; the median age at diagnosis for colon cancer is 68 in men and 72 in women; for rectal cancer it is 63 years of age in both men and women.[15] As a result of rising CRC incidence rates in younger age groups coincident with declining rates in older age groups, the proportion of cases diagnosed in individuals younger than age 50 increased from 6% in 1990 to 11% in 2013.[16] Most of these cases (72%) occur in people who are in their 40s.

Sex

CRC incidence rates are approximately 30% higher in men than in women, while mortality rates are approximately 40% higher (Figure 3, page 3). Reasons for the gender disparity are not fully understood, but partly reflect differences in exposures to risk factors (e.g., cigarette smoking) and sex hormones, as well as complex interactions between these influences.[17] Research on the relationship between estrogen and CRC is inconclusive. While a recent study found that higher natural levels of estrogen among postmenopausal women were associated with reduced CRC risk,[18] other studies have found increased risk[19] or no association.[20]

Race/ethnicity

CRC incidence and mortality rates are highest in non-Hispanic blacks (NHBs) and lowest in Asians/Pacific Islanders (APIs). During 2009-2013, CRC incidence rates in blacks were about 20% higher than those in non-Hispanic whites (NHWs) and 50% higher than those in APIs. The disparity for mortality is twice that for incidence; CRC death rates in blacks are 40% higher than in NHWs and double those in APIs. Reasons for racial/ethnic disparities in CRC are complex, but largely reflect differences in socioeconomic status. According to the US Census Bureau, 24% of blacks lived in poverty in 2015, compared to 11% of Asians and 9% of NHWs.[21] People with the least education (used in studies to estimate socioeconomic status) are 40% more likely to be diagnosed with CRC than those with the most education.[22] Close to half (44%) of the socioeconomic disparity is attributed to differences in the prevalence of behavioral factors associated with CRC (e.g., smoking, obesity).[23] (See page 11 for information on risk factors for CRC.) A similar proportion (42%) of the racial disparity in incidence is estimated to be due to differences in CRC screening, which combined with lower stage-specific survival accounts for about half of the racial disparity in CRC mortality.[24]

It is important to recognize that the broad racial and ethnic groups to which cancer statistics are generally limited represent very heterogeneous populations, within which the CRC burden varies greatly. For example, although CRC incidence in API men overall is 18% lower than in NHW men, rates in Japanese and Hawaiian men are slightly higher than those in NHWs.[25] Even more striking is the burden in Alaska Natives, who have the highest CRC incidence (91 per 100,000) and mortality (37 per 100,000) rates in the United States, about 80% higher than those in blacks (49 and 21, respectively) and more than double those in NHWs (40 and 15, respectively).[16] CRC has been the most commonly diagnosed cancer in Alaska Natives since the early 1970s for reasons that are uncertain, but may include a higher prevalence of CRC risk factors, such as a diet high in animal fat and low in fruits and vegetables, vitamin D deficiency, smoking, obesity, and diabetes.[26, 27] In addition, Alaska Natives, particularly rural residents, have a high prevalence of *Helicobacter pylori*,[28] a bacterium associated with inflammation and cancer of the stomach, but that may also be associated with CRC risk.[29, 30]

How has colorectal cancer occurrence changed over time?

Incidence

CRC incidence increased from 1975 through the mid-1980s, but has since generally decreased (Figure 4). The decline in incidence before 2000 is attributed equally to changing patterns in risk factors (e.g., reductions in smoking) and the uptake of CRC screening.[31] However, the acceleration in the decline, from about 2% per year prior to the mid-2000s to 3% per year from 2004-2013, is thought to predominantly reflect the detection and removal of precancerous polyps as a result of increased CRC screening. Despite higher incidence rates in men than in women, trends are similar by sex.

Age

CRC trends reflect patterns in older age groups, among whom the majority of cases occur, masking trends in young individuals. From 2009 to 2013, CRC incidence rates decreased by 4.6% per year in individuals 65 years of age and older and by 1.4% per year in individuals 50-64, but increased by 1.6% per year in adults younger than 50.[16] Notably, the increase in young adults followed a decade of rapid declines during the late 1970s and early 1980s (Figure 5, page 6). Reasons for the rise in young age groups are unknown, but may reflect an increased sedentary lifestyle and a higher prevalence of obesity and/or unfavorable dietary patterns in children and young adults.[32]

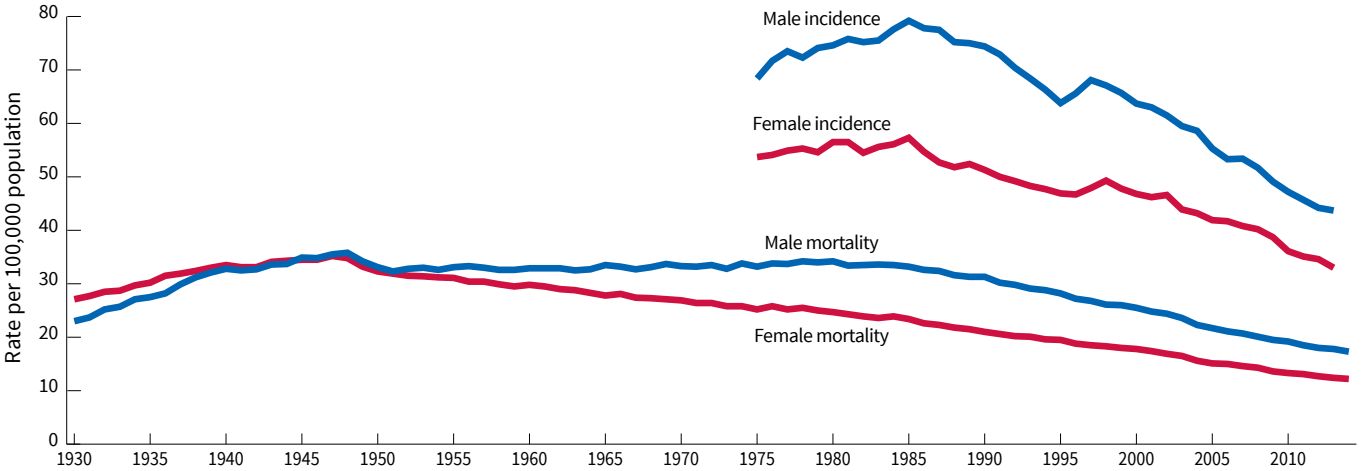
Race/ethnicity

Long-term cancer incidence data in the US are available only for whites and blacks. CRC incidence was similar in whites and blacks until the mid-1980s, when rates began declining in whites while remaining stable in blacks, creating a racial gap that increased until the mid-2000s, but has since remained fairly stable (Figure 6, page 7). The divergence likely reflects a combination of earlier and more rapid access to and utilization of CRC screening tests among whites, as well as differences in the prevalence of CRC risk factors.[33] CRC incidence rates are currently declining rapidly for all broadly defined racial/ethnic groups except American Indians/Alaska Natives (AIs/ANs), among whom rates remain stable. Over the past 5 data years (2009-2013), rates declined by about 3% per year in NHWs, NHBs, and Hispanics and by 2% per year in APIs.

Mortality

CRC death rates have been decreasing since 1980 in men and since 1947 in women, although trends over the past three decades are very similar by sex (Figure 4). Declines in mortality from 1975 to 2000 are attributed to

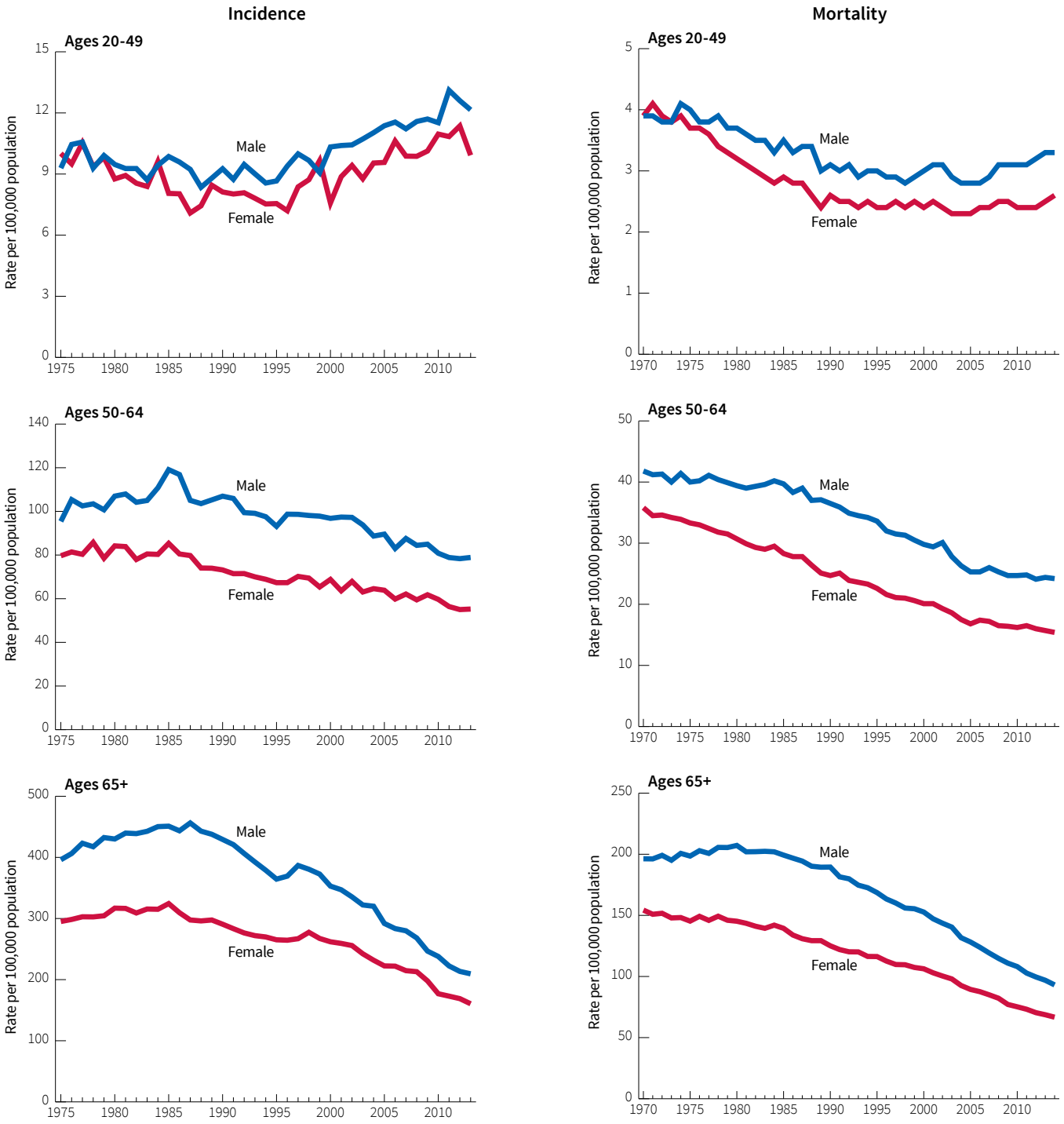
Figure 4. Trends in Colorectal Cancer Incidence (1975-2013) and Mortality (1930-2014) Rates by Sex, US



Rates are age adjusted to the 2000 US standard population. Incidence rates are adjusted for delays in reporting. Due to improvements in International Classification of Diseases (ICD) coding over time, numerator data for mortality differ slightly from those presented elsewhere.

Source: Incidence – SEER Program, National Cancer Institute, 2016. Mortality – US Mortality Volumes 1930 to 1959, US Mortality Data 1960-2014, National Center for Health Statistics, Centers for Disease Control and Prevention, 2016.

Figure 5. Trends in Colorectal Cancer Incidence (1975-2013) and Mortality (1970-2014) Rates by Age and Sex, US



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

Source: Incidence – SEER Program, National Cancer Institute, 2016. Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2016.

improvements in treatment (12%), changing patterns in CRC risk factors (35%), and screening (53%).[31] The rate of decline accelerated slightly in the past decade; from 2005 to 2014, rates decreased by an average of 2.5% per year in both men and women, compared to declines of about 2% per year during the 1990s. However, progress has lagged in the highest-poverty areas of the US, including the lower Mississippi Delta and parts of Appalachia.[34]

Age

Similar to incidence rates, CRC death rates in adults younger than 50 years of age increased by about 1% per year from 2005 to 2014 following decades of decline (Figure 5). This trend is in contrast to older age groups, among whom death rates are decreasing by about 1% per year in individuals 50-64 years of age and by 3% per year in those 65 and older.

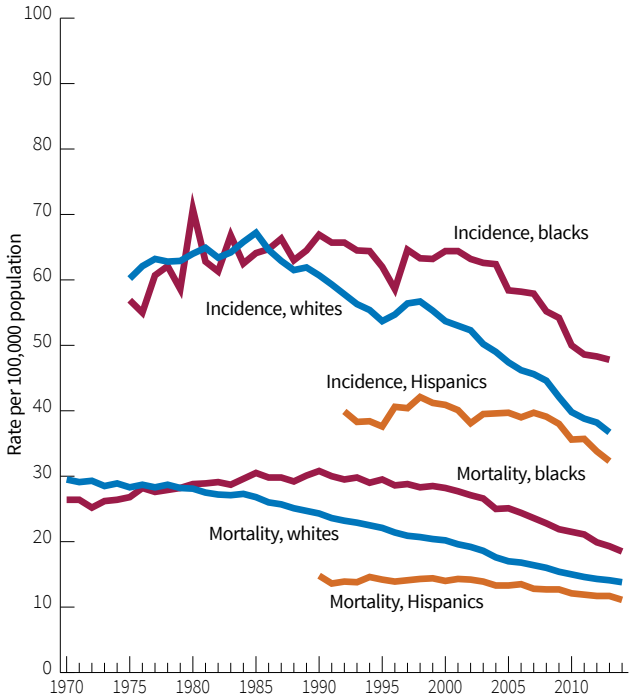
Race/ethnicity

CRC death rates in whites began a slow decline in the early 1970s that accelerated over time. In contrast, death rates in blacks increased from the early 1970s until 1990, decreased sluggishly during the 1990s, then began matching the pace of the decline in whites during the 2000s (Figure 6). As a result of these divergent trends, CRC death rates in blacks went from being 10% lower than those in whites in the early 1970s to almost 50% higher in 2005. The widening racial disparity was largely driven by distant-stage disease, which declined in whites while remaining stable in blacks through the mid-2000s.[35] About half of the racial disparity is attributed to a combination of less screening and lower stage-specific survival rates among blacks.[24] From 2005 to 2014, CRC death rates declined by about 2% per year in NHWs, Hispanics, and APIs; by 3% per year in NHBs; and were stable in AIs/ANs. As a result of the rapid declines in death rates in blacks over the past decade, the black-white gap has begun to narrow.

Are there geographic differences in colorectal cancer occurrence?

The geographic pattern of CRC has changed dramatically over the past several decades. In contrast to the 1970s and 1980s, when death rates were highest across the Northeast and lowest in the South, rates are currently highest in parts of the deep South and Midwest (Figure 7, page 8). The shift from the Northeast to the South during the latter half of the 20th century is consistent with the racial and socioeconomic crossover in disease burden that occurred during that time period (Figure 6).[36] Geographic patterns are generally similar for blacks and whites, particularly for mortality, highlighting the larger influence of socioeconomic status than race on cancer disparities.[34, 37]

Figure 6. Trends in Colorectal Cancer Incidence (1975-2013) and Mortality (1970-2014) Rates by Race/Ethnicity, US

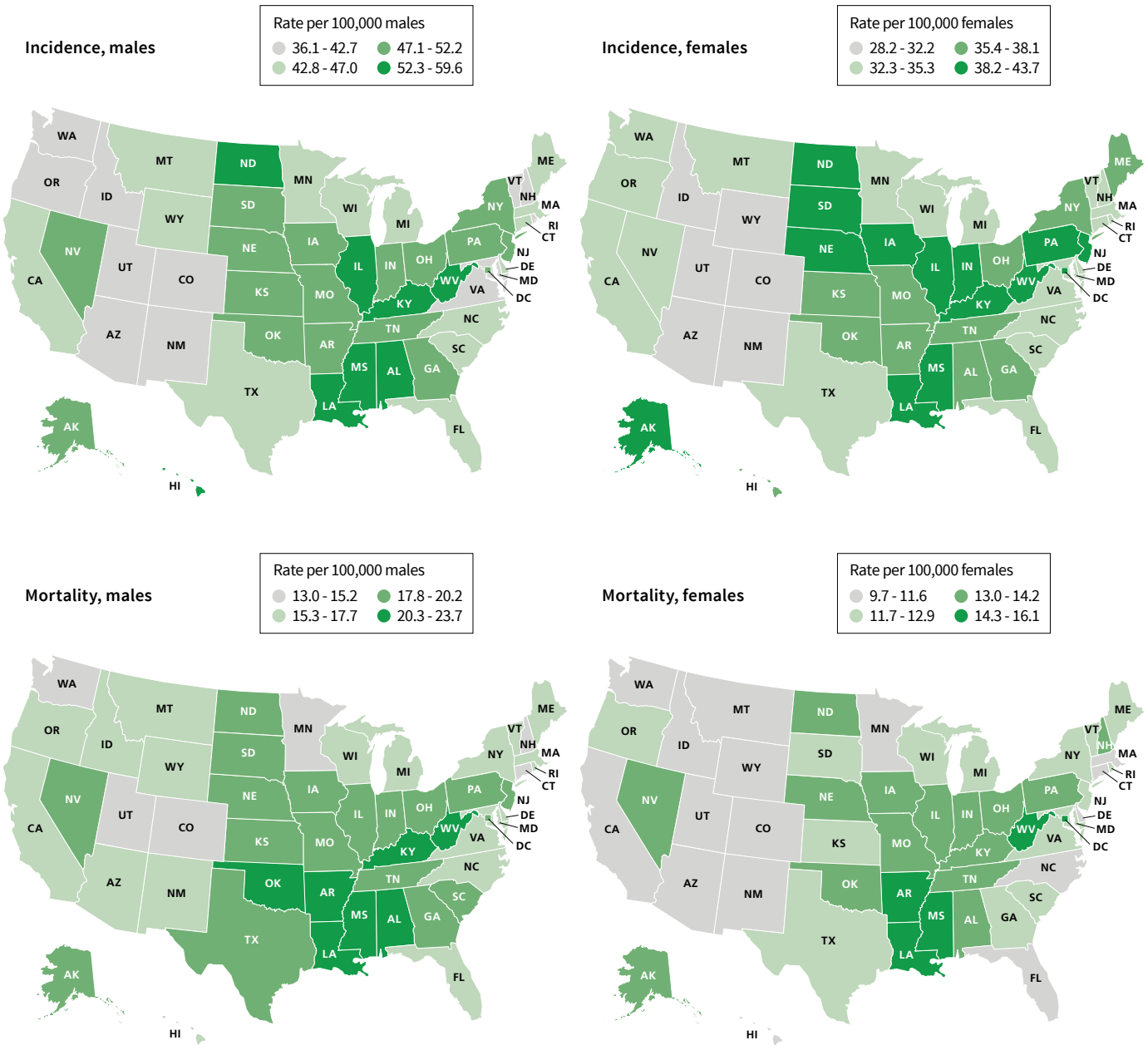


Rates are age adjusted to the 2000 US standard population. Incidence rates are adjusted for reporting delays. White and black race are not mutually exclusive from Hispanic ethnicity. Hispanic death rates exclude data from Louisiana, New Hampshire, and Oklahoma.

Source: Incidence – SEER Program, National Cancer Institute, 2016. Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2016.

Table 1 (page 9) shows the variation in state-level incidence and death rates per 100,000 people by race/ethnicity. State rates differ up to two-fold for both incidence and mortality among men in all three racial/ethnic groups, while the variation is smaller among women except for Hispanics. Incidence rates in white men and women are lowest in the District of Columbia and highest in Kentucky. While data for AIs/ANs are too sparse to provide by state, a recent study found that incidence rates for those living in Alaska (92.7 per 100,000) were almost three-fold higher than those living in the Southwest US (31.0 per 100,000) during 2005-2009.[27] Factors that contribute to geographic disparities include regional variations in risk factors and access to screening and treatment, which are influenced by socioeconomic factors, legislative policies, and proximity to medical services. Among some more isolated groups (e.g., Alaska natives), genetic differences may also play a role.

Figure 7. Geographic Variation in Colorectal Cancer Incidence (2009-2013) and Mortality (2010-2014) Rates by Sex, US



Rates are age adjusted to the 2000 standard population. Minnesota, Nevada, and New Mexico did not meet NAACCR high-quality incidence data standards for one or more years during 2009-2013. Incidence rates for Nevada and New Mexico are for 2009-2010 and 2009-2012, respectively.

Sources: Incidence – NAACCR, 2016. Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2016.

Stage distribution and cancer survival

The relative survival rate for CRC is 65% at 5 years following diagnosis and 58% at 10 years.[16] Only 39% of CRC patients are diagnosed with localized-stage disease, for which the 5-year survival rate is 90%; survival declines to 71% and 14% for patients diagnosed with regional and distant stages, respectively. Rectal cancer is diagnosed at a localized stage more often than colon cancer, 43% versus 38%, likely due to the earlier appearance of symptoms. Overall 5-year relative survival is slightly higher for rectal cancer (67%) than colon cancer (64%).

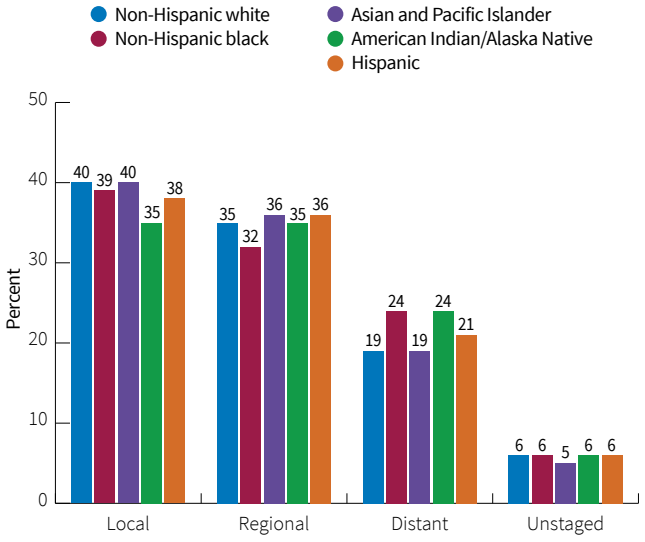
Table 1. Colorectal Cancer Incidence (2009-2013) and Mortality (2010-2014) Rates* by Race/Ethnicity and State, US

	Incidence						Mortality					
	Men			Women			Men			Women		
State	Non-Hispanic white	Non-Hispanic black	Hispanic	Non-Hispanic white	Non-Hispanic black	Hispanic	Non-Hispanic white	Non-Hispanic black	Hispanic	Non-Hispanic white	Non-Hispanic black	Hispanic
Alabama	50.6	65.2	20.4	35.5	44.8	20.0	19.1	29.2	†	12.1	18.7	†
Alaska	41.2	†	†	33.5	†	†	14.2	†	†	11.5	†	†
Arizona	38.6	41.6	43.1	30.4	38.1	28.9	15.5	21.0	16.2	11.5	18.6	9.2
Arkansas	49.1	58.5	64.7	35.6	45.2	49.1	21.2	31.0	†	14.4	18.0	†
California	43.9	57.6	40.4	34.7	45.6	28.3	16.1	25.0	14.8	12.3	18.1	8.7
Colorado	37.3	47.9	45.8	30.7	34.1	32.0	14.2	21.5	16.2	11.1	12.6	10.6
Connecticut	45.0	57.8	55.6	34.3	40.9	34.7	13.7	19.6	11.9	10.4	12.6	7.8
Delaware	44.5	48.8	33.0	33.7	35.8	†	17.2	16.3	†	10.5	14.8	†
Dist. Of Columbia	24.0	63.0	30.8	25.9	49.1	†	7.0	26.5	†	9.5	19.3	†
Florida	41.9	52.3	47.3	32.3	37.2	34.4	16.0	21.7	15.9	11.3	14.8	10.3
Georgia	46.9	60.4	31.0	34.4	43.6	26.0	18.1	27.1	10.4	11.7	16.2	3.5
Hawaii	42.7	†	48.0	33.3	†	44.4	14.7	†	21.0	12.2	†	†
Idaho	41.8	†	38.5	31.9	†	24.7	16.2	†	†	11.2	†	†
Illinois	52.9	69.4	37.6	38.3	49.4	28.8	18.6	29.8	12.6	13.0	19.5	7.5
Indiana	49.4	55.7	33.0	39.0	45.5	30.3	19.1	26.4	11.4	13.3	18.6	†
Iowa	52.4	53.2	31.4	40.0	46.8	21.9	19.3	20.0	†	14.0	21.2	†
Kansas	47.9	64.5	44.2	35.5	43.6	28.1	18.2	29.8	15.1	12.2	21.0	10.9
Kentucky	59.6	64.3	26.5	43.5	51.9	†	20.9	23.3	†	14.1	18.2	†
Louisiana	54.3	70.3	30.1	38.9	51.3	33.5	19.8	29.7	†	13.7	19.2	†
Maine	44.9	†	†	35.6	†	†	16.6	†	†	11.8	†	†
Maryland	41.5	49.9	28.0	32.8	38.6	23.5	16.3	25.3	6.9	11.2	15.9	5.4
Massachusetts	43.6	49.6	35.5	34.9	36.8	26.8	16.2	17.4	10.6	11.2	14.2	9.4
Michigan	43.1	58.1	47.4	33.4	43.8	27.1	16.9	25.3	15.3	12.1	17.2	10.5
Minnesota‡	43.7	43.5	33.9	34.3	39.9	33.0	15.2	12.8	†	11.4	10.6	†
Mississippi	54.2	74.4	†	38.0	54.0	†	21.0	33.2	†	13.9	21.4	†
Missouri	49.7	62.9	36.7	36.8	45.2	26.0	18.6	27.4	†	12.9	17.6	†
Montana	44.5	†	†	32.9	†	†	15.5	†	†	10.9	†	†
Nebraska	49.3	71.6	32.7	38.5	52.1	27.9	18.4	36.9	†	14.3	19.7	†
Nevada‡,§	52.0	60.1	36.0	34.7	47.2	34.8	21.1	24.4	13.2	14.7	16.4	9.6
New Hampshire	41.4	†	†	34.6	†	†	14.3	†	†	13.6	†	†
New Jersey	49.9	57.7	45.1	39.2	43.1	35.5	18.4	28.0	11.9	13.2	15.8	8.7
New Mexico‡,¶	36.3	†	48.0	29.3	†	32.9	15.5	†	20.1	10.5	†	12.1
New York	47.4	55.0	47.0	37.2	39.6	31.4	16.5	21.4	15.3	12.1	14.6	10.0
North Carolina	43.3	55.9	27.3	32.2	39.9	22.9	16.2	26.3	6.9	10.8	16.3	3.5
North Dakota	54.4	†	†	39.6	†	†	18.3	†	†	12.9	†	†
Ohio	48.4	53.3	29.6	35.7	38.1	23.8	19.5	25.3	13.2	13.5	15.9	6.0
Oklahoma	47.6	56.2	41.3	35.8	42.9	35.5	20.1	29.0	14.1	13.2	17.8	9.0
Oregon	41.6	58.6	39.6	32.3	38.8	28.5	16.7	27.7	12.5	12.3	18.7	8.7
Pennsylvania	50.8	58.5	46.5	38.2	43.0	29.9	18.4	27.0	14.0	13.3	16.5	7.7
Rhode Island	42.6	36.1	37.4	35.3	30.9	22.7	16.3	†	†	13.6	†	†
South Carolina	43.3	56.1	26.4	33.0	38.4	26.6	17.3	26.1	†	12.1	16.3	†
South Dakota	50.2	†	†	39.4	†	†	19.4	†	†	12.5	†	†
Tennessee	46.9	59.8	21.3	35.8	43.7	20.1	19.2	31.1	†	13.3	19.9	†
Texas	46.3	60.5	46.8	33.0	43.7	28.1	17.6	28.4	17.8	12.0	17.8	9.6
Utah	36.0	68.6	37.8	27.9	†	29.6	12.6	†	15.0	9.6	†	9.5
Vermont	41.4	†	†	33.6	†	†	15.8	†	†	12.7	†	†
Virginia‡	40.9	53.2	30.4	32.4	40.6	25.8	16.1	25.1	8.4	11.3	16.4	8.2
Washington	41.6	47.3	29.5	34.2	32.7	28.0	15.4	20.5	7.6	11.5	12.4	6.9
West Virginia	54.5	54.5	†	40.9	42.3	†	22.2	30.9	†	15.2	13.4	†
Wisconsin	43.6	68.6	36.7	33.7	41.0	30.4	16.2	29.3	†	11.9	17.1	8.4
Wyoming	44.0	†	41.4	32.2	†	†	17.0	†	†	10.5	†	†
US	**46.1**	**58.3**	**42.8**	**35.2**	**42.7**	**29.8**	**17.3**	**25.9**	**15.0**	**12.3**	**16.9**	**9.2**

*Rates are per 100,000 and age adjusted to the 2000 US standard population. †Statistics not displayed due to fewer than 25 cases or deaths. ‡This state's incidence data are not included in US combined rates because it did not meet NAACCR high-quality standards for one or more years during 2009-2013. §Incidence rates are based on data for 2009-2010. ¶Incidence rates are based on data for 2009-2012.

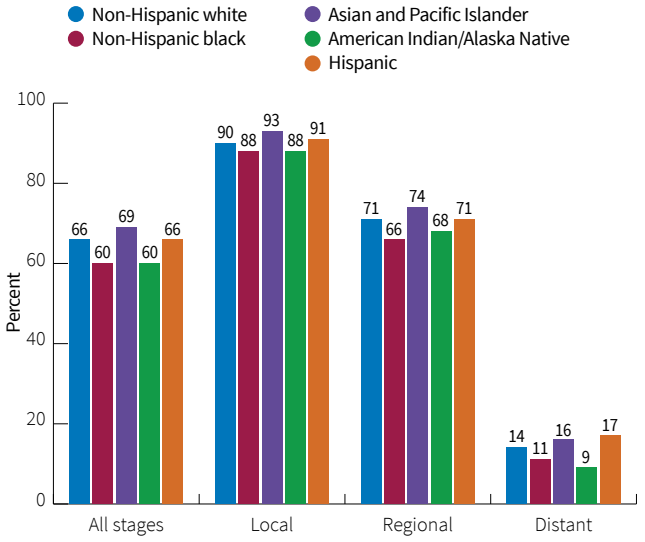
Sources: Incidence – NAACCR, 2016. Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2016.

Figure 8. Colorectal Cancer Stage Distribution (%) by Race/Ethnicity, US, 2006-2012



Source: SEER Program, National Cancer Institute, 2016.

Figure 9. Colorectal Cancer-specific Five-year Survival (%) by Race/Ethnicity, US, 2006-2012



Cause-specific survival rates are the probability of not dying from colorectal cancer within 5 years of diagnosis. Rates are based on cases diagnosed from 2006 to 2012, all followed through 2013. Rates for American Indians/Alaska Natives are based on small case numbers, particularly for distant-stage disease.

Source: SEER Program, National Cancer Institute, 2016.

Based on cause-specific survival, which is used to report on outcomes among racial/ethnic minorities (because of inadequate data on life expectancy), AIs/ANs are least likely of all racial/ethnic groups to be diagnosed with CRC at a localized stage (35%), and most likely, along with blacks, to be diagnosed with distant-stage disease (24%; Figure 8). APIs are most likely to survive 5 years after a CRC diagnosis, 69% versus 60% among both blacks and AIs/ANs (Figure 9).

Disparities in CRC survival are largely driven by socioeconomic inequalities that result in differences in access to early detection tests and the receipt of timely, high-quality treatment.[38-41] According to the US Census Bureau, 29% of AIs/ANs and 27% of blacks lived in poverty during 2010-2014, compared to 11% of non-Hispanic whites.[42] A recent study estimated that 40% of the racial disparity in colon cancer survival is due to the combined effects of later stage at diagnosis, more unfavorable tumor characteristics, and more comorbidities (other illnesses) among black patients.[43] While differences in treatment may play a lesser role, there is compelling evidence that black patients are less likely than others to receive appropriate surgery, adjuvant chemotherapy, and radiation treatments.[43-46]

However, even when treatment is equal, survival is lower in black than in white patients, despite the same response to therapy.[47, 48] Survival disparities are evident within as well as between racial and ethnic groups. For example, blacks who are privately insured are 46% more likely to survive 5 years after a CRC diagnosis than blacks who are uninsured.[49]

Based on long-term data from the National Cancer Institute, the 5-year relative survival rate for colon cancer increased from 51% in the mid-1970s to 66% during 2006-2012, and similarly from 48% to 68% for rectal cancer.[15] There was a striking improvement in 5-year survival for distant-stage disease over the past two decades, from 7% during 1987-1989 to 14% during 2006-2012 for colon cancer and from 4% to 12% for rectal cancer. The progress for advanced disease is due to improvements in surgery and chemotherapy.[50-52] However, gains in survival for metastatic disease are confined to non-Hispanic whites, Asians, and patients younger than 65 years of age,[53] highlighting the need for further dissemination of optimal treatment to older and underserved populations.

Colorectal Cancer Risk Factors

Aside from age and race, many of the known risk factors for CRC are behaviors traditionally associated with high-income countries, such as a sedentary lifestyle, Western diet, and smoking. The prevalence of these factors is reflected in the substantial variation in CRC incidence worldwide, which is highest in Europe and North America and lowest in sub-Saharan Africa. The relationship between CRC and a Western lifestyle is so strong that increasing rates of the disease are considered a marker of economic transition.[54] People living in high-income countries who have a healthy lifestyle have lower CRC risk than the general population. A recent study found that maintaining a healthy weight, being physically active, limiting alcohol consumption, and eating a healthy diet reduce the risk of CRC by more than one-third (37%).[55]

Nonmodifiable factors that increase risk are related to heredity and medical history, including a personal or family history of CRC or adenomatous polyps and a personal history of chronic inflammatory bowel disease over a long time period. Most people at increased risk because of a medical or family history should begin CRC screening before age 50. (For more information on CRC screening guidelines, please see page 15.) The following sections present current knowledge about factors associated with CRC risk.

Heredity and family history

Up to 30% of CRC patients have a family history of the disease, about 5% of which are due to an inherited genetic abnormality.[56] People with a first-degree relative (parent, sibling, or child) who has been diagnosed with CRC have 2 to 4 times the risk of developing the disease compared to people without this family history, depending on the age at diagnosis and number of affected relatives (Table 2).[57, 58] Risk is highest for people with multiple first-degree relatives diagnosed with colon cancer. Recent studies indicate that familial risk extends beyond first-degree relatives.[59] Risk is also slightly increased among people with a first- or second-degree relative diagnosed with adenomas.[60]

Knowledge about familial CRC has increased rapidly in recent years. Much of the CRC clustered in families is thought to be due to the interaction between lifestyle factors and the cumulative effect of relatively common genetic variations that increase disease risk,[61] as opposed to rare hereditary syndromes that more strongly influence risk. Characterized hereditary syndromes account for about 5% of all CRCs and are associated with specific gene mutations.[56] The most common hereditary CRC syndrome is Lynch syndrome (formerly known as hereditary nonpolyposis CRC or HNPCC), which accounts for approximately 2% to 4% of all cases. Individuals with Lynch syndrome are also at increased risk for a wide variety of other cancers, including endometrial, ovarian, small intestine, and stomach.[62] Among people with Lynch syndrome, an estimated 18% of men and 19% of women

Table 2. Relative Risks for Established Colorectal Cancer Risk Factors

	Relative risk*
Factors that increase risk:	
Heredity and medical history	
Family history	
1 first-degree relative[57]	2.2
More than 1 relative[57]	4.0
Relative with diagnosis before age 45[58]	3.9
Inflammatory bowel disease[81]	1.7
Diabetes[87]	1.3
Behavioral factors	
Alcohol consumption (daily average)[145]	
2-3 drinks	1.2
>3 drinks	1.4
Obesity (body mass index ≥30 kg/m^2)[104]	1.3
Red meat consumption (100 g/day)[131]	1.2
Processed meat consumption (50 g/day)[131]	1.2
Smoking (ever vs. never)[136]	1.2
Factors that decrease risk:	
Physical activity (colon)[97]	0.7
Dairy consumption (400 g/day)[119]	0.8
Milk consumption (200 g/day)[119]	0.9

*Relative risk compares the risk of disease among people with a particular "exposure" to the risk among people without that exposure. Relative risk for dietary factors compares the highest with the lowest consumption. If the relative risk is more than 1.0, then risk is higher among exposed than unexposed persons. Relative risks less than 1.0 indicate a protective effect.

will develop CRC by age 50, rising to 45% and 54%, respectively, by age 70.[63] Median age at CRC diagnosis is 45 to 50 years.[64] The US Multi-Society Task Force on Colorectal Cancer, which is composed of specialists representing the major gastroenterology organizations in the US, has published detailed guidelines for the genetic evaluation and management of patients with or at high risk for Lynch syndrome.[65]

Familial adenomatous polyposis (FAP) is the second most common predisposing genetic syndrome, accounting for fewer than 1% of all CRCs. It is characterized by the development of hundreds to thousands of colorectal polyps beginning at 10-12 years of age.[66] Without intervention, the lifetime risk of CRC approaches 100% by age 40.[67] The genetic mutation that causes FAP is usually inherited, but can also occur spontaneously, so FAP-affected persons do not always have a family history of the disease. Surgery is the standard method of cancer prevention for people with FAP. Attenuated FAP is a less severe form of the condition with a later age at onset and in which fewer polyps (<100) develop, although the lifetime risk of developing CRC remains high.[68] Most people with *MUTYH*-associated polyposis (MAP) seem to develop a similar number of polyps as those with attenuated FAP, although the clinical features of this genetic syndrome are less well defined; for example, not all CRC patients with MAP have polyps.[69]

There is growing interest in improving methods for identifying high-risk individuals and families because of the large potential for CRC prevention and early detection. In addition, most people who have a genetic predisposition for CRC are also at increased risk for other cancers.[70] Presently, only about 1% of the estimated 800,000 Americans with Lynch syndrome are aware of their disease because diagnosis of the syndrome doesn't usually occur until after a cancer diagnosis.[71] Although some groups have recommended genetic testing for Lynch syndrome in all CRC patients,[72] neither this approach nor screening the general population is cost-effective because of the rarity of the condition.[73] Currently, accurate identification of family history in medical records remains the most important strategy for identifying families with hereditary cancer syndromes.

However, family history of disease in general is lacking in approximately half of primary care patient medical records.[74, 75] Moreover, a study of CRC patient medical records found that only 22% had complete information on family history, necessary for identifying individuals who should be offered referral for genetic counseling and/or testing.[76] Recognizing individuals at high risk allows the opportunity for screening surveillance, which has been shown to reduce CRC incidence and mortality by half in people with Lynch syndrome.[77] However, because polyp removal does not prevent all cancers, there is increasing emphasis on chemoprevention, such as with nonsteroidal anti-inflammatory drugs like aspirin.[66] Although there are currently no medications approved for CRC prevention in high-risk populations, aspirin therapy substantially reduces the risk of CRC cancer among Lynch syndrome patients.[78]

Personal medical history

People with a personal history of CRC are more likely to develop a subsequent cancer in the colon or rectum, especially when the initial diagnosis was at a young age.[79] A history of adenomatous polyps also increases the risk of CRC, especially multiple polyps.[80]

Chronic inflammatory bowel disease

People who have chronic inflammatory bowel disease, a condition in which the colon is inflamed over a long period of time, have almost double the risk of developing CRC compared to people in the general population.[81] The most common forms of inflammatory bowel disease are ulcerative colitis and Crohn disease. Cancer risk increases with the extent, duration, and severity of disease,[81, 82] but has decreased over time, likely due to increased use of medications to control inflammation and screening surveillance to detect premalignant lesions.[83] Inflammatory bowel disease is most common in developed countries,[84] and while data are sparse in the US, prevalence appears to have increased in recent years.[85] Inflammatory bowel disease has been diagnosed in an estimated 3.1 million Americans and is most common in non-Hispanic whites and in those with the least education and highest poverty.[86]

Diabetes

People who have type 2 (adult onset) diabetes have an increased risk of CRC.[87] Although type 2 diabetes and CRC share many risk factors, including obesity and a sedentary lifestyle, this association remains even after accounting for physical activity, body mass index, and waist circumference.[88] Although some studies suggest that metformin, a drug commonly used to lower blood glucose levels in diabetic patients, independently reduces CRC incidence,[89-93] a randomized controlled trial found no association.[94] The number of Americans with a history of diabetes doubled from 3.5 per 100 people in 1990 to 8.3 in 2012.[95] According to the Centers for Disease Control and Prevention, approximately 29 million people (9% of the population) were diabetic in 2014, including 8 million of whom were undiagnosed.[96]

Behavioral risk factors

Physical inactivity

Physical activity is strongly associated with a reduced risk of colon cancer, but not rectal cancer. Studies consistently show that the most physically active people have a 25% lower risk of developing both proximal and distal tumors than the least active people.[97, 98] Additionally, people who are more physically active before a CRC diagnosis are less likely to die from the disease than those who were less active.[99] One analysis of many studies found that people who are the most sedentary (e.g., spend the most hours watching TV) have a 25% to 50% increased risk of colon cancer compared to those who are least sedentary.[100] Even sedentary people who become active later in life may reduce their risk.[101] Based on these findings, as well as the numerous other health benefits of regular physical activity, the American Cancer Society and the Centers for Disease Control and Prevention recommend that adults engage in at least 150 minutes of moderate-intensity activity or 75 minutes of vigorous-intensity activity each week (or a combination of these), preferably spread throughout the week. The percentage of US adults who met these physical activity guidelines increased from 41% in 2006 to 50% in 2012, but has since remained stable.[102]

Overweight and obesity

The prevalence of obesity among US adults 20-74 years of age has more than doubled, from 15% in 1979 to 35% in 2014.[103] Excess body weight increases the risk of CRC, with a stronger association in men than in women and for colon than for rectal tumors. Specifically, compared to people who are normal weight, obese men have about a 50% higher risk of colon cancer and a 20% higher risk of rectal cancer, whereas obese women have about a 20% increased risk of colon cancer and a 10% increased risk of rectal cancer.[104] The excess risk conferred by obesity is independent of physical activity.[105] Abdominal obesity, measured by waist circumference, also increases risk,[104] and the use of body mass index in combination with waist circumference may be a more informative indicator of excess risk than either measurement alone.[106] Weight gain appears to have a greater influence on CRC risk when it occurs in early adulthood versus later in life.[107, 108] In addition, high body weight measured prior to diagnosis reduces the likelihood of CRC survival.[109, 110] Excess body weight can have a negative impact on metabolic health, which is the proper functioning of all of the biochemical processes in the body. Recent studies indicate that poor metabolic health may be related to CRC incidence and survival independent of obesity.[111, 112]

Diet

Differences in CRC incidence globally, as well as relatively rapid changes in risk among immigrant populations in the United States, suggest that diet strongly influences CRC occurrence.[113] Dietary patterns likely influence risk directly, through specific dietary elements, and indirectly, through overnutrition and obesity. Diet also has a large influence on the collective microorganisms (i.e., the microbiome) in the large intestine, where bacterial cells outnumber host cells 10-to-1.[114, 115] The composition of this diverse environment is increasingly thought to play both a positive and negative role in tumor development through its influence on immune response and inflammation.[116, 117] The direct role of specific food items in cancer occurrence is extremely challenging to study for many reasons, including 1) difficulty defining and measuring intake, such as challenges in the accuracy of self-reported food questionnaires ; 2) differences in the sources of dietary constituents (e.g., cereal grains, fruits,

and vegetables all contribute to fiber intake); and 3) the strong link between dietary patterns and other health behaviors. The following is a summary of the current scientific evidence for dietary elements linked to CRC:

Calcium: Most studies find that calcium consumption from dairy foods and/or supplements is associated with a decreased risk of developing adenomas and CRC.[118, 119] Adequate calcium intake appears to confer protection, with limited additional benefit for higher consumption. Additionally, the association may require years of follow-up to observe and be confined to cancers in the distal colon and rectum.[120-122]

Fiber: Although it is highly plausible that dietary fiber decreases risk of CRC for many reasons, including less exposure to carcinogens because of higher stool volume and faster transit time, study results, including those from randomized controlled trials, remain inconclusive.[118] However, because of the overall health benefit of a high-fiber diet, the American Cancer Society and the World Cancer Research Fund advocate a diet high in whole grains, fruits, and vegetables for the prevention of cancer.[123-125]

Folate: Folate intake, consumed through diet or supplements, appears to have a complex relationship with CRC risk, potentially promoting growth of pre-existing tumors, while inhibiting formation of new tumors in healthy tissue.[118] There has been speculation that increased folate levels among Americans as a result of mandatory fortification of enriched flour and cereals in 1998 were responsible for the unexplained uptick in CRC incidence rates in the late 1990s (Figure 4, page 5).[126] However, this hypothesis is not supported by a recent analysis of data from randomized controlled trials that found no association between folic acid supplementation and CRC risk within the first 5 years of treatment.[127] Potential anticancer benefits also appear to require long-term follow-up (10-15 years) to observe.[128]

Fruits and vegetables: Similar to fiber, results from numerous studies specifically evaluating the association between fruit and vegetable intake and CRC risk are inconsistent.[118] Any protective effect appears to be for moderate compared to low consumption, with high consumption adding little additional benefit.[129, 130]

Red and processed meat: Consumption of red and/or processed meat increases the risk of both colon and rectal cancer.[131] The reasons for this association remain unclear, but may be related to the constituents of meat and/or to carcinogens (cancer-causing substances) that form during high-temperature cooking, curing, and/or smoking.[132] In 2015, the International Agency for Research on Cancer classified processed meat as "carcinogenic to humans" and red meat as "probably carcinogenic to humans," largely based on the evidence related to CRC risk.[133]

Vitamin D: Higher blood levels of vitamin D may be associated with lower risk of CRC, although study results remain inconclusive.[118] Recent results from a clinical trial found that daily supplementation with vitamin D did not reduce risk of adenomas.[122] Forthcoming data from several large ongoing clinical trials evaluating the effect of vitamin D supplementation on cancer prevention may help clarify this association.[134]

Smoking

In November 2009, the International Agency for Research on Cancer reported that there is sufficient evidence to conclude that tobacco smoking causes CRC.[135] The association appears to be stronger for rectal than for colon cancer and for particular molecular subtypes of CRC.[136-138] Smoking is also associated with lower CRC-specific survival,[139, 140] particularly for current smokers.[141]

Alcohol

Moderate and heavy alcohol use,[142, 143] but not light drinking (<12.5 grams per day, about one drink), is associated with increased risk of CRC.[144] Compared with nondrinkers and occasional drinkers, people who have a lifetime average of 2 to 3 alcoholic drinks per day have about a 20% higher risk of CRC, and those who consume more than 3 drinks per day have about a 40% increased risk.[145] The association is stronger in men than in women, perhaps because of hormone-related differences in alcohol metabolism.

Medications

Nonsteroidal anti-inflammatory drugs

There is extensive evidence that long-term regular use of aspirin and other nonsteroidal anti-inflammatory drugs (NSAIDS) lowers risk of CRC.[146-148] Aspirin users who do develop CRC appear to have less aggressive tumors and better survival compared to non-aspirin users.[149] The American Cancer Society has not conducted a formal evidence review, but currently does not recommend the use of these drugs for cancer prevention in the general population because of the potential side effects of serious gastrointestinal bleeding or heart attack from selective COX-2 inhibitors (a type of NSAID commonly used to treat arthritis). However, the US Preventive Services Task Force recently completed a review of the evidence, and currently recommends daily low-dose aspirin for the prevention of cardiovascular disease and CRC for certain individuals in their 50s who are at increased risk for cardiovascular disease; the evidence for individuals in their 60s was less convincing.[150] Decisions about aspirin use should be made after discussion with a health care provider. Visit uspreventiveservicestaskforce.org for more information about their recommendation.

Hormones

The evidence regarding the association between postmenopausal hormone use and CRC is inconsistent. While observational studies generally find decreased risk in women with recent hormone use,[151, 152] long-term follow-up data from randomized controlled trials find no meaningful association.[153] Differences in the association by cancer subtype[154, 155] and drug formulation may partly explain these inconsistencies. Similarly, although a large body of past evidence indicated that recent oral contraceptive use is associated with reduced CRC risk,[156, 157] more recent studies do not support this association.[158, 159]

Other drugs

Recent studies suggest that oral bisphosphonates, which are used to treat and prevent osteoporosis, may reduce CRC risk.[160]

Colorectal Cancer Screening

The slow course of growth from precancerous polyp to invasive cancer provides a unique opportunity for the prevention and early detection of CRC.[4] Screening can prevent cancer through the detection and removal of precancerous growths and can detect cancer at an early stage, when treatment is usually more successful. As a result, screening reduces CRC mortality both by decreasing incidence of disease and by increasing the likelihood of survival. Screening is recommended beginning at age 50 for people at average risk of CRC, but earlier for most people at increased risk because of family history or certain medical conditions (see page 11).
The appropriate age to initiate screening and rescreening intervals differs based on individual circumstances, so people at increased risk should discuss screening with their health care provider. Colonoscopy is the recommended screening method for most individuals at increased risk.

Visit cancer.org/cancer/colon-rectal-cancer/early-detection/acs-recommendations for more information about prevention and early detection of CRC, including specific guidelines for screening individuals at increased or high risk.

Recommended options for colorectal cancer screening

There are several recommended methods for CRC screening, including both visual examinations, which are performed at a health care facility, and stool-based tests, which are performed at home (Table 3, page 16). All tests have a comparable ability to reduce CRC death when performed at the appropriate time intervals and with the recommended follow-up.[161] Positive results from any test other than colonoscopy should be followed with a colonoscopy for complete diagnostic evaluation. Patients should be given information about the benefits and limitations of each screening test, and choose one

Table 3. Considerations When Deciding with Your Doctor Which Test Is Right for You

	Benefits	Performance & Complexity*	Limitations	Test Time Interval
Visual Examinations				
Colonoscopy	• Examines entire colon • Can biopsy and remove polyps • Can diagnose other diseases • Required for abnormal results from all other tests	**Performance:** Highest **Complexity:** Highest	• Full bowel cleansing • Can be expensive • Sedation usually needed, necessitating a chaperone to return home • Patient may miss a day of work. • Highest risk of bowel tears or infections compared with other tests	10 years
Computed tomographic colonography (CTC)	• Examines entire colon • Fairly quick • Few complications • No sedation needed • Noninvasive	**Performance:** High (for large polyps) **Complexity:** Intermediate	• Full bowel cleansing • Cannot remove polyps or perform biopsies • Exposure to low-dose radiation • Colonoscopy necessary if positive • Not covered by all insurance plans	5 years
Double-contrast barium enema	• Can usually view entire colon • Few complications • No sedation needed	**Performance:** High (for large polyps) **Complexity:** High	• Full bowel cleansing • Some false-positive test results • Cannot remove polyps or perform biopsies • Exposure to low-dose radiation • Colonoscopy necessary if abnormalities are detected • Very limited availability	5 years
Flexible sigmoidoscopy	• Fairly quick • Few complications • Minimal bowel preparation • Does not require sedation or a specialist	**Performance:** High for rectum & lower one-third of the colon **Complexity:** Intermediate	• Partial bowel cleansing • Views only one-third of colon • Cannot remove large polyps • Small risk of infection or bowel tear • Slightly more effective when combined with annual fecal occult blood testing • Colonoscopy necessary if positive • Limited availability	5 years
Stool Tests (Low-sensitivity stool tests, such as single-sample FOBT done in the doctor's office or toilet bowl tests are not recommended.)				
Fecal immuno-chemical test (FIT)	• No bowel cleansing or sedation • Performed at home • Low cost • Noninvasive	**Performance:** Intermediate for cancer **Complexity:** Low	• Requires multiple stool samples • Will miss most polyps • May produce false-positive test results • Slightly more effective when combined with a flexible sigmoidoscopy every five years • Colonoscopy necessary if positive	Annual
High-sensitivity guaiac-based fecal occult blood test (gFOBT)	• No bowel cleansing • Performed at home • Low cost • Noninvasive	**Performance:** Intermediate for cancer **Complexity:** Low	• Requires multiple stool samples • Will miss most polyps • May produce false-positive test results • Pre-test dietary limitations • Slightly more effective when combined with a flexible sigmoidoscopy every five years • Colonoscopy necessary if positive	Annual
FIT-DNA test (Cologuard®)	• No bowel cleansing • Can be performed at home • Requires only a single stool sample • Noninvasive	**Performance:** Intermediate for cancer **Complexity:** Low	• Will miss most polyps • More false-positive results than other tests • Higher cost than gFOBT and FIT • Colonoscopy necessary if positive	3 years, per manufacturer's recommendation

*Complexity involves patient preparation, inconvenience, facilities and equipment needed, and patient discomfort.

based on their health, medical history, and preferences; advice from a health care professional may be helpful. A growing body of evidence demonstrates that offering patients different test options substantially increases adherence to screening recommendations.[162, 163] As a result, and because one-third of eligible adults in the US have never been screened,[164] the US Preventive Services Task Force's updated recommendations in 2016 stress the convincing evidence that CRC screening can help save lives instead of emphasizing specific screening tests.[165]

Visual examinations

Colonoscopy

Colonoscopy is the most common screening test for CRC in the US. This procedure, which is usually performed by a gastroenterologist, allows for direct visual examination of the entire colon and rectum. It is performed for screening purposes, as well as after abnormal results from any other screening test. Before undergoing a colonoscopy, patients are instructed to take special laxative agents to cleanse the colorectum completely so the intestinal lining can be thoroughly examined. During the exam, the colon is inflated with either air or carbon dioxide. Carbon dioxide is used less often, but is safer (because it eliminates the small risk of explosion during polypectomy) and causes less discomfort after the procedure.[166, 167] Then a long, slender instrument called a colonoscope is inserted into the anus and moved slowly through the rectum and colon to the cecum. The colonoscope has a light and small video camera on the end, which allows for the detection and removal of most polyps with a wire loop or electric current. Sedation is usually provided during examinations in the US, although it is used less frequently in some European countries (e.g., Norway and Poland).[166] Colonoscopy has the longest rescreening interval of all test options; if the results are normal, the exam does not need to be repeated for 10 years in average-risk patients.

While data are not yet available from randomized controlled trials evaluating the effectiveness of colonoscopy,[168] data from several completed trials of flexible sigmoidoscopy, which is very similar, provide indirect support for the benefit of colonoscopy. In addition, observational studies suggest that colonoscopy can help reduce CRC incidence by about 40% and mortality by about 50%.[169, 170] Reductions in mortality partly reflect the lower incidence of late-stage disease.[171] However, the quality of the colonoscopy in the US is variable and influences these benefits.[172]

Limitations of colonoscopy include a higher risk of complications compared to other screening tests, such as bowel tears and bleeding, especially when a polyp is removed.[173] Although these side effects are rare, serious bleeding occurs in 1 to 2 of every 1,000 colonoscopies.[166, 174, 175] In addition, colonoscopy can miss some adenomas, especially those that are flat, referred to as sessile adenomas, from which 20% to 30% of CRCs are thought to originate.[168] Missed lesions may progress to invasive colorectal cancers, which can progress to the point where symptoms are evident years before the next scheduled exam.[176] Although previous studies found colonoscopy to be much less effective at finding lesions in the proximal colon, early results from two European randomized controlled trials reported similar adenoma detection rates for the proximal and distal colon.[166, 175]

Flexible sigmoidoscopy

Sigmoidoscopy was a common screening test before the widespread adoption of colonoscopy beginning around 2000, but current availability of the test is limited and prevalence among screening aged adults (50 years or older) had plummeted to just 2.5% in 2015.[177] Sigmoidoscopy is very similar to colonoscopy except that it allows visualization only of the rectum and lower one-third of the colon (sigmoid colon).[173] Simple bowel cleansing, usually with enemas, is necessary to prepare the colon, and the procedure is often performed without sedation in a general health care practitioner's office. If there is a polyp or tumor present, the patient is referred for a colonoscopy so that the entire colon can be examined.

Analysis of data from randomized controlled trials indicates that sigmoidoscopy is associated with about a 20% reduction in CRC incidence and a 30% reduction in CRC mortality.[178-180] Studies based on patient self-reported screening history over time find a 40% reduction in CRC mortality.[170]

Computed tomographic colonography (CTC)

Also referred to as virtual colonoscopy, this imaging procedure was introduced in the 1990s and results in detailed, cross-sectional 2- or 3-dimensional views of the entire colon and rectum with the use of a special x-ray machine linked to a computer.[173] Although a full bowel cleansing is necessary for a successful examination, sedation is not required. A small, flexible tube is inserted into the rectum in order to allow carbon dioxide, or sometimes air, to open the colon; then the patient passes through the CT scanner, which creates multiple images of the interior colon that may be viewed in 2D or 3D, the latter simulating a "virtual" colonoscopy. CTC is less invasive than colonoscopy or sigmoidoscopy, requires no recovery time, and typically takes approximately 10 to 15 minutes to complete.[181] Patients with polyps larger than 5 millimeters or other abnormal results are referred for colonoscopy, optimally on the same day in order to alleviate the necessity of a second bowel preparation.

Studies have shown that the performance of CTC is similar to colonoscopy for the detection of invasive cancer and polyps approximately 1 centimeter or larger in size, but has lower sensitivity for smaller polyps.[182] Potential harms include incidental findings outside the colorectum, which may lead to unnecessary tests and/or treatment, and radiation exposure. There is less evidence on the benefits and harms of this test compared to others because it is relatively new and remains uncommon.[165] In 2015, only 0.7% of screening-eligible adults reported a CTC in the past 5 years.[177] This may be because it is not covered by Medicare, although it is covered by most private insurance companies.

Double-contrast barium enema

In this test, which is also called barium enema with air contrast, barium sulfate is introduced into a cleansed colon through the rectum to partially fill and open the colon. Air is then introduced to further expand the colon and then x-rays are taken. This method is less sensitive than colonoscopy for visualizing small polyps or cancers. If a polyp or other abnormality is seen, the patient should be referred for a colonoscopy. Use of this procedure has become very uncommon due to the increased availability of colonoscopy, changing patient and physician preferences, a limited number of radiologists adequately trained to perform the procedure, and lower insurance reimbursement.

Stool tests

Cancerous tumors and some large polyps bleed intermittently into the intestine. This blood, which may not be visible, can be detected in stool with special tests. Modeling studies suggest that annual screening with high-sensitivity stool tests will result in a reduction in CRC mortality comparable to that achieved by colonoscopy over a lifetime of screening.[161] However, adherence to yearly testing is a challenge in the community setting.[183-185] Patients with a positive stool test are further evaluated with a diagnostic colonoscopy.

Guaiac-based fecal occult blood test (gFOBT)

These tests use a chemical reaction to detect blood in the stool. Bleeding from CRC may be sporadic or undetectable, so accurate test results require annual testing of 3 samples from consecutive bowel movements. Patients are instructed to avoid nonsteroidal anti-inflammatory drugs and red meat for 3 days prior to the test because they can lead to false-positive results. (gFOBT detects blood from any source, including meat in the diet.) Vitamin C and large amounts of citrus juices should also be avoided because they can lead to false-negative test results.

Data from a large clinical trial indicated that the regular use of FOBT reduced the risk of death from CRC by 32% after 30 years of follow-up.[186] In addition, FOBT has been shown to decrease the incidence of CRC by 20% by detecting large precancerous polyps.[187]

Fecal immunochemical test (FIT)

The FIT (also sometimes referred to as the immunochemical FOBT, or iFOBT) uses antibodies against hemoglobin to detect hidden blood in the stool. Early versions of this test were not as good at detecting cancer as current, highly sensitive versions, which have been on the market for more than 10 years. FIT is more convenient than gFOBT because it requires no dietary restrictions (because it only detects human blood) and

usually requires the collection of fewer stool samples. FIT is also specific for bleeding occurring in the colorectum, and thus has fewer false-positive results than gFOBT among populations with a high prevalence of *Helicobacter pylori* infection (e.g., American Indians and Alaska Natives), which can cause stomach bleeding.[188] Studies have found that compared to gFOBT, FIT is more likely to be completed by patients and is about twice as likely to detect both advanced adenomas and cancer, depending on the gFOBT product.[189, 190]

FIT-DNA (Cologuard®)

This test is referred to as "multi-targeted" because it not only detects blood in the stool, but also certain genetic mutations in the DNA of cells that are shed into the stool by large adenomas and CRC. Patients with a positive test result are referred for a colonoscopy. Cologuard® has been shown to detect cancer and precancerous lesions more often than FIT, but also results in more false-positive tests, which can lead to unnecessary colonoscopies.[191] In addition, because it is new, the benefits and harms of this test are less well established than for other tests. Although it is recognized as an acceptable screening option by the US Preventive Services Task Force[165] and is covered by Medicare, some private insurance companies may not cover this test.

Other stool-based tests

Occasionally during the course of an appointment with a physician, a single stool sample is collected during a digital rectal exam and placed on an FOBT card for CRC screening. Despite the absence of evidence and lack of endorsement for this form of testing by any organization, with many specifically recommending against it, the in-office FOBT is still performed by some primary care physicians.[192] The single-sample FOBT is not a recommended screening test for CRC because it performs poorly in its ability to detect the disease; in one large study this approach missed 19 of 21 cancers found by colonoscopy.[193]

"Toilet bowl tests" are guaiac-based tests that are often promoted as a type of FOBT. They consist of strips of paper to be dropped into the toilet water with your stool and are sold in drugstores and other retail outlets. These tests have not been evaluated in the types of rigorous clinical studies done on the guaiac-based FOBT and the FIT and are not recommended for CRC screening by the American Cancer Society or any other major medical organization.

Use of colorectal cancer screening

According to the National Health Interview Survey, CRC screening in accordance with guidelines among adults 50 years of age and older increased from 34% in 2000 to 63% in 2015.[194] Additionally, in 2015:

- Only 7% of adults 50 and older reported having an FOBT or FIT in the previous year, while 60% reported having either a sigmoidoscopy in the past 5 years or colonoscopy in the past 10 years (Table 4, page 20).
- Adults ages 50-64 (58%) were less likely to have been screened than those ages 65 and older (68%).
- Screening prevalence among whites (65%) and blacks (62%) was higher than that among AIs/ANs (54%), Hispanics (50%), and Asians (49%).
- Screening was lowest among the uninsured (25%) and immigrants who had resided in the US fewer than 10 years (34%).

The prevalence of CRC screening also varies substantially by state (see cover). According to data from the Behavioral Risk Factor Surveillance System (BRFSS) for 2014:[195]

- Screening utilization ranged from 58% in Wyoming to 76% in Massachusetts (Figure 10, page 21, and Table 5, page 22).
- In all states, screening rates are substantially lower in people ages 50-64 than in those 65 and older, with the largest absolute difference of 24% in Nevada and Florida.
- Among adults ages 65 and older, the prevalence of screening was higher than 80% in nine states (California, Delaware, Florida, Maine, Maryland, Michigan, New Hampshire, Rhode Island, and Wisconsin).

The 80% by 2018 Initiative

The National Colorectal Cancer Roundtable (NCCRT), established in 1997 by the American Cancer Society and the CDC, is a coalition of more than 100 member organizations and individual experts dedicated to reducing CRC incidence and mortality in the US through coordinated leadership, strategic planning, and advocacy.

The ultimate goal of the NCCRT is to increase the use of recommended CRC screening tests among appropriate populations. In March 2014, the NCCRT launched the 80% by 2018 initiative, an ambitious goal to reach an 80% CRC screening rate of adults 50 and older by 2018. Over 1,200 organizations – including health plans, medical professional societies, hospitals systems, survivor groups, government agencies, and cancer coalitions – have pledged to make this goal a priority. The key components of the effort are: 1) moving consumers to action; 2) activating key partners, such as community health centers; 3) increasing access to screening; and 4) evaluating progress and maintaining momentum. If this goal is reached, an estimated 277,000 CRC cases and 203,000 CRC deaths will be averted by 2030.[196]

Signature NCCRT activities to advance the effort include:

- Releasing the *Steps for Increasing Colorectal Cancer Screening Rates: A Manual for Community Health Centers*, which provides step-by-step instructions to help community health centers increase colorectal cancer screening
- Releasing an 80% by 2018 Communications Guidebook based on market research from the American Cancer Society, to mobilize key audiences that are not getting screened for colorectal cancer
- Launching the Links of Care pilot program to improve access to specialists and hospitals for community health center patients in the delivery of colorectal cancer screening and follow-up care

Visit nccrt.org/80by2018 for more tools and resources.

NATIONAL Colorectal Cancer ROUNDTABLE

EIGHTYBY2018 SCREENING SAVES LIVES Reaching 80% screened for colorectal cancer by 2018

Table 4. Colorectal Cancer Screening (%), Adults 50 Years and Older, US, 2015

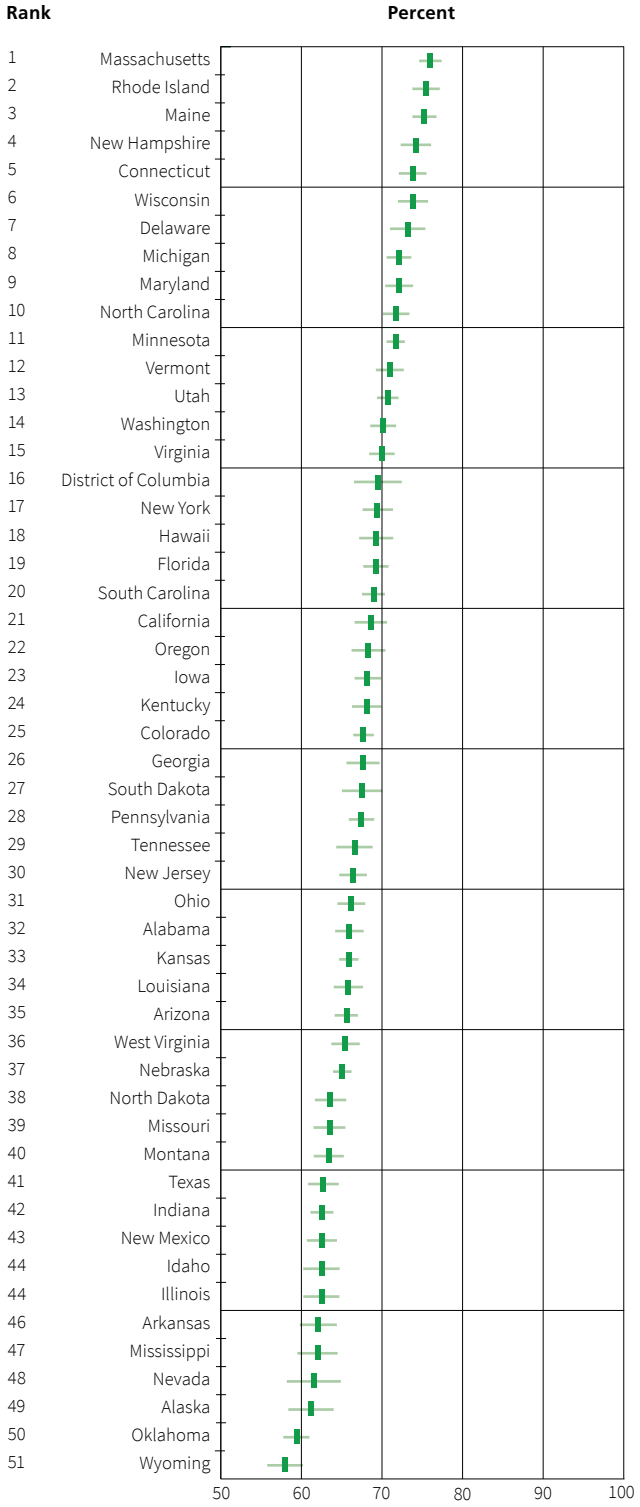
	Fecal test*	Endoscopy†	Combined Fecal/ Endoscopy‡
Overall	7.2	60.3	62.6
Gender			
Males	7.6	60.9	63.2
Females	6.8	59.9	62.2
Age (years)			
50-64	6.0	55.3	57.8
65+	8.6	66.1	68.3
Race/ethnicity§			
White	6.9	63.3	65.4
Black	8.0	59.3	61.8
Hispanic	7.3	47.6	49.9
American Indian/Alaska Native	**	49.6	54.3
Asian	9.2	44.8	49.4
Education			
Some high school or less	6.3	45.3	47.4
High school diploma or GED	7.1	56.4	58.6
Some college/Assoc. degree	7.2	61.6	64.3
College graduate	7.7	68.9	71.3
Sexual orientation			
Gay/Lesbian	**	68.0	71.8
Straight	7.2	60.3	62.7
Bisexual	**	52.0	53.2
Insurance status (age 50-64 years)			
Uninsured	4.0	24.0	25.1
Insured	6.2	56.8	59.6
Immigration status			
Born in US	7.1	62.4	64.7
Born in US territory#	**	62.5	63.4
In US fewer than 10 years	**	25.6	33.7
In US 10+ years	8.0	48.8	51.8
Region			
Northeast	5.0	64.5	65.5
Midwest	4.5	62.6	64.0
South	6.7	59.3	61.0
West	12.6	55.8	61.3

GED: General Education Development high school equivalency. *Fecal occult blood test (FOBT) or fecal immunochemical test (FIT) within the past year. †A sigmoidoscopy within the past five years or a colonoscopy within the past 10 years. ‡Either an FOBT or FIT within the past year, a sigmoidoscopy within the past five years, or a colonoscopy within the past 10 years. §Estimates for whites, blacks, American Indians/Alaska Natives and Asians are among non-Hispanics. Estimate for Asians does not include Native Hawaiians or other Pacific Islanders. #Have been in the US for any length of time. **Estimate not provided due to instability.

Note: The colorectal cancer screening prevalence estimates do not distinguish between examinations for screening and diagnosis. Estimates are age adjusted to the 2000 US standard population.

Source: Centers for Disease Control and Prevention. National Health Interview Survey, 2015. Public use data file. See Sources of Statistics (page 29) for complete citation and more information.

Figure 10. Colorectal Cancer Screening* (%), Adults Age 50 Years and Older by State, 2014



*A fecal occult blood test within the past year or sigmoidoscopy within the past 5 years or colonoscopy within the past 10 years. Note: The colorectal cancer screening prevalence estimates do not distinguish between examinations for screening and diagnosis.

Source: Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System 2014. Public Use Data file. See Sources of Statistics (page 29) for complete citation and more information.

Strategies to overcome screening barriers

Despite the large body of evidence supporting the effectiveness of CRC screening and the availability of a variety of test options, screening utilization for CRC remains lower than for breast and cervical cancers.[197] Utilization of CRC screening is influenced by both general and individual factors. Barriers to cancer screening are more common among people with fewer financial resources, resulting in disparities in screening prevalence. Research suggests that the causes of screening disparities differ among racial and ethnic minorities, thus requiring specific targeted interventions to address these gaps.[198] Public policy and health care providers, systems, and settings all play a role in screening utilization. Screening-related challenges include no usual source of care, inadequate insurance coverage, lack of provider recommendation, logistical factors (e.g., transportation, scheduling, and language), fear, and lack of knowledge.[199-204] Fortunately, there are strategies to help overcome many of these barriers. The National Colorectal Cancer Roundtable's 80% by 2018 initiative (see sidebar) has produced evidence-based toolkits for a variety of health care providers.[205, 206] Additionally, in September 2015, the Centers for Disease Control and Prevention committed an additional $23 million to their Colorectal Cancer Control Program (CRCCP), which aims to increase population-level CRC screening, especially among low-income, underinsured, or uninsured individuals and certain racial and ethnic groups, using evidence-based strategies.[207]

At the patient level, CRC screening prevalence increases when patients are offered a variety of tests.[162, 163, 208, 209] Additionally, directly mailing FOBT or FIT kits to screening-eligible persons helps limit some logistical barriers.[210] Patient navigation systems have also been shown to increase screening uptake.[211-213] On a broader scale, provisions of the Patient Protection and Affordable Care Act (ACA) have helped reduce cost- and access-related barriers to cancer screening by reducing the number of uninsured persons and reducing or eliminating out-of-pocket screening costs for those who are insured.[214] However, although screening colonoscopy is covered with no cost sharing for patients in Medicare

Table 5. Colorectal Cancer Screening* by Age, Race/Ethnicity, and State, 2014

	All races				Non-Hispanic white	Non-Hispanic black†
	≥50 years		50-64 years	≥65 years	≥50 years	≥50 years
	Rank (1=high)	%	%	%	%	%
United States (median)		**67.6**	**60.8**	**76.1**	**68.7**	**67.8**
Range		*58.0-76.0*	*51.3-73.4*	*68.5-81.8*	*58.5-77.3*	*57.3-85.9*
Alabama	32	65.9	58.0	76.9	67.0	65.7
Alaska	49	61.2	56.6	71.6	61.0	‡
Arizona	35	65.6	57.1	75.9	68.1	70.6
Arkansas	46	62.1	55.3	70.5	62.6	61.1
California	21	68.6	60.7	80.1	74.1	79.3
Colorado	25	67.7	61.4	78.0	69.1	76.1
Connecticut	5	73.8	70.0	79.1	75.3	71.5
Delaware	7	73.2	67.0	81.7	74.9	67.4
District of Columbia	16	69.5	63.6	78.2	76.3	64.7
Florida	19	69.2	57.9	81.8	72.2	68.8
Georgia	26	67.6	60.8	78.2	69.4	69.3
Hawaii	18	69.3	65.5	74.1	71.2	‡
Idaho	44	62.5	53.9	74.0	64.1	‡
Illinois	44	62.5	57.2	70.3	64.6	57.3
Indiana	42	62.5	56.5	71.2	63.0	64.1
Iowa	23	68.2	63.2	74.8	69.2	60.0
Kansas	32	65.9	59.9	74.1	67.7	60.4
Kentucky	24	68.1	62.7	75.6	68.2	68.0
Louisiana	34	65.8	58.2	76.8	66.8	64.2
Maine	3	75.2	71.0	80.8	75.9	‡
Maryland	9	72.1	65.9	81.5	73.0	71.3
Massachusetts	1	76.0	73.4	79.9	77.3	66.3
Michigan	8	72.1	66.0	80.8	73.1	71.5
Minnesota	11	71.7	67.6	78.0	72.7	68.7
Mississippi	47	62.0	54.6	72.4	63.8	58.7
Missouri	39	63.5	56.8	72.7	63.7	65.6
Montana	40	63.4	56.4	72.8	64.5	‡
Nebraska	37	65.0	60.1	71.8	65.9	69.1
Nevada	48	61.6	51.6	75.6	64.4	71.1
New Hampshire	4	74.2	69.4	81.7	74.7	‡
New Jersey	30	66.4	59.9	76.0	68.7	64.0
New Mexico	43	62.5	57.0	69.9	66.8	67.8
New York	17	69.4	64.0	77.0	70.6	68.6
North Carolina	10	71.8	66.6	78.8	72.9	72.4
North Dakota	38	63.6	56.8	73.1	64.5	‡
Ohio	31	66.2	59.8	75.0	65.8	73.0
Oklahoma	50	59.4	51.5	70.3	60.8	59.2
Oregon	22	68.3	60.8	78.4	69.4	‡
Pennsylvania	28	67.4	62.8	73.6	68.3	65.9
Rhode Island	2	75.5	71.6	80.9	76.6	72.4
South Carolina	20	69.0	61.4	78.8	70.8	65.8
South Dakota	27	67.5	62.2	74.7	68.4	‡
Tennessee	29	66.6	59.1	76.6	66.4	67.1
Texas	41	62.7	55.8	73.4	68.0	75.9
Utah	13	70.7	65.5	78.5	72.8	‡
Vermont	12	71.0	67.2	76.5	71.1	‡
Virginia	15	70.0	65.9	76.1	70.9	67.3
Washington	14	70.1	65.5	76.9	72.5	72.2
West Virginia	36	65.4	59.3	73.1	65.8	60.6
Wisconsin	6	73.8	68.9	80.6	73.9	85.9
Wyoming	51	58.0	51.3	68.5	58.5	‡

*A fecal occult blood test within the past year or sigmoidoscopy within the past five years or colonoscopy within the past 10 years. †Median is for 39 states with adequate data. The 95% confidence interval is +/- ≥5.0% for all states except Alabama, Georgia, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, and Virginia, and the District of Columbia. ‡Estimate not provided due to instability. Note: These estimates include diagnostic examinations.

Source: Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System, 2014. Public use data file. See Sources of Statistics (page 29) for complete citation and more information.

and most commercial insurance plans, the required colonoscopy performed in follow-up to a positive FIT is often coded as a diagnostic procedure, resulting in out-of-pocket costs for patients. In addition, Medicare still imposes cost sharing on beneficiaries who have a polyp removed during a screening colonoscopy. These policies may undermine efforts to improve CRC screening, particularly among low-income patients who are at highest risk for CRC.[215]

Visit cancer.org/colonmd for more information on programs and resources aimed at increasing CRC screening.

Colorectal Cancer Treatment

Treatment for CRC has advanced rapidly over the past several decades, including improvements in imaging, surgical techniques, and chemotherapy.[51, 216] However, it has also become increasingly clear that treatment outcomes vary widely based on tumor-specific molecular features.[217] Treatment decisions are made by patients with their physicians after considering the best options available for the stage, location, and other tumor characteristics, as well as the risks and benefits associated with each.

Colon cancer

Most people with colon cancer will have some type of surgery to remove the tumor. Adjuvant chemotherapy (chemotherapy given after surgery) may also be used. Radiation is used less often to treat colon cancer.

Carcinoma in situ

Carcinoma in situ is cancer that has not spread beyond the layer of cells in which it began. Surgery to remove the growth of abnormal cells may be accomplished by polypectomy (polyp removal) or local excision through the colonoscope. Resection of a segment of the colon may be necessary if the tumor is too large to be removed by local excision or if cancer cells are found after the polyp is removed.

Localized stage

Localized stage refers to invasive cancer that has penetrated the wall of the colon. Surgical resection to remove the cancer, together with a length of colon on either side of the tumor and nearby lymph nodes, is the standard treatment.

Regional stage

Regional stage includes cancers that have grown through the wall of the colon, as well as cancers that have spread to nearby lymph nodes. If the cancer has only grown through the wall of the colon but has not spread to nearby lymph nodes, surgical resection of the segment of colon containing the tumor and the surrounding lymph nodes may be the only treatment needed. If the cancer is likely to come back because it has spread to other tissues or has high-risk characteristics, chemotherapy may also be recommended. If the cancer has spread to nearby lymph nodes, surgical resection of the segment of colon containing the tumor is the first treatment, usually followed by chemotherapy. Adjuvant chemotherapy based on the drug fluorouracil (5-FU) is typically used in patients with stage III or high-risk stage II disease who are in otherwise good health.[218] Oxaliplatin is often part of adjuvant chemotherapy as well.[219] However, some patients may not tolerate this regimen given its toxicity, and there is growing appreciation for the need to confine its use to those patients who are most likely to benefit.[51, 220, 221] Adjuvant chemotherapy for colon cancer is as effective in patients ages 70 and older (almost half of all patients) who are otherwise as healthy as younger patients, although certain drugs (e.g., oxaliplatin) may be avoided to limit toxicity. However, studies indicate that individuals 75 and older are far less likely than younger patients to receive this treatment.[51, 222]

Distant stage

At this stage, the cancer has spread to distant organs and tissues, such as the liver, lungs, peritoneum (lining of the abdomen), or ovaries. When surgery is performed, the goal is usually to relieve or prevent blockage of the colon

and to prevent other local complications. If there are only a few metastases to the liver or lungs, surgery to remove these, as well as the colon tumor, may improve survival.

Chemotherapy and biologically targeted therapies may be given alone or in combination to relieve symptoms and prolong survival. A number of targeted therapies have been approved in recent years by the US Food and Drug Administration to treat metastatic CRC. Some of these drugs inhibit new blood vessel growth to the tumor by targeting a protein called vascular endothelial growth factor (VEGF). Others interfere with cancer cell growth by targeting the epidermal growth factor receptor (EGFR) or other proteins. Tumors with certain genetic mutations do not benefit from treatment with some of these drugs.[223]

Rectal cancer

Surgery is usually the main treatment for rectal cancer, often accompanied by chemotherapy and radiation before and/or after surgery to reduce the risk of spread and recurrence. The chemotherapy drugs used in the treatment of rectal cancer are the same as those for nonmetastatic colon cancer.

Carcinoma in situ

Removing or destroying the growth of abnormal cells is all that is needed. Treatment options include polypectomy (polyp removal), local excision, or full-thickness rectal resection. This resection may be carried out through the anus. No further treatment is needed.

Localized stage

At this stage, the cancer has grown through the first layer of the rectum into deeper layers, but has not spread outside the rectal wall. Some small localized rectal cancers may be treated by removal through the anus, without an abdominal incision. For other cancers, depending on the location, surgery may involve removal of the cancer and some surrounding normal tissue through one or more small abdominal incisions. For cancers close to the anus, surgery may require removal of the anus and the sphincter muscle, so a permanent colostomy is required (see next section for information about colostomy). In most cases, no further treatment is needed unless the tumor has high-risk features. Patients who are not candidates for surgery may be treated with radiation therapy.

Regional stage

At this stage, the cancer has grown through the wall of the rectum, and may have spread into nearby tissues and/or lymph nodes. Patients with regional-stage disease are increasingly treated with chemotherapy and radiation (chemoradiaton) before surgery. Some patients also receive chemotherapy after surgery, although the benefit remains controversial.[224-226]

Distant stage

In this stage, the cancer has spread to distant organs and tissues, such as the liver or lung. In rare cases, the cancer can be successfully treated by removing all of the tumors with surgery, along with other treatments. Otherwise, surgery, chemotherapy, and/or radiation therapy are used to relieve, delay, or prevent symptoms and to prolong life.

Colostomy

When a section of the colon or rectum is removed during surgery, the healthy parts can usually be connected, allowing the patient to eliminate waste normally. However, sometimes reconnection is not possible immediately. In this case, the surgeon connects the colon to an opening (a stoma) that is made in the skin of the abdomen, allowing waste to leave the body. The surgical procedure to create an opening in the body for the elimination of waste is called an ostomy. When the stoma is connected to the colon it is called a colostomy; when the stoma is connected to the small intestine it is called an ileostomy. Usually a flat bag fits over the stoma, held in place by a special adhesive, to collect waste.

Most patients with CRC who require a colostomy need it only temporarily, until the colon or rectum heals from surgery. After healing takes place, usually in 6 to 8 weeks, the surgeon reconnects the ends of the colon and closes the stoma. A permanent colostomy is necessary more often for rectal than for colon cancer patients.

A person with an ostomy learns to care for it with help from doctors, nurses, and enterostomal therapists (health professionals trained to care for people with stomas). If surgery is expected to result in an ostomy, an enterostomal therapist will often visit the patient before surgery to explain what to expect and how to care for the ostomy. They also provide information about lifestyle issues, including emotional, physical, and sexual concerns, as well as resources and support groups.

Side effects of colorectal cancer treatment

Although many side effects that occur during cancer treatment are temporary, some persist after treatment has ended (long-term effects) and others do not arise until several years later (late effects). For example, surgical patients and those treated with radiation are at increased risk of future bowel obstruction. Side effects should be discussed with a clinician because treatment options are often available. To manage the long-term and late effects of treatment, the American Cancer Society has established guidelines to aid primary care clinicians in delivering risk-based care to CRC survivors.[123] Short- and long-term effects of specific modes of CRC treatment are described in the following sections.

American Cancer Society Colorectal Cancer Survivorship Care Guidelines

Colorectal cancer patients have specific needs and concerns once treatment ends. In 2015, a multidisciplinary expert workgroup published evidence- and consensus-based posttreatment care guidelines for clinicians to aid in providing comprehensive, long-term care for colorectal cancer survivors. These guidelines include information on surveillance for cancer recurrence, screening for new cancers, management of chronic and late effects, and referrals for rehabilitation, psychosocial and palliative care, or other specialty care.

Visit cancer.org/health-care-professionals/american-cancer-society-survivorship-guidelines/colorectal-cancer-survivorship-care-guidelines.html for full text of the guidelines, as well as resources for clinicians.

Surgery

The time needed to heal after surgery is different for each person. Patients often have some pain for the first few days that can usually be controlled with medication. It can take a few days to be able to eat normally again. About 25% of patients experience a delay in bowel function (postoperative ileus) because of bowel stress caused by manipulation, which may require an extended hospital stay.[227] Patients are monitored for signs of bleeding, infection, or other problems that require immediate treatment.

Side effects from surgery for CRC may include:

- Fatigue, possibly for an extended period of time
- Frequent or urgent bowel movements, diarrhea, constipation, gas, and/or bloating, particularly among rectal cancer patients
- A temporary or permanent colostomy
- Urogenital/sexual dysfunction (e.g., erectile dysfunction in men)

Radiation therapy

Side effects of radiation therapy can include skin irritation, nausea, diarrhea, rectal irritation and/or painful inflammation, bladder irritation, fatigue, or sexual problems. Rectal irritation or inflammation can lead to the urge to defecate frequently and rectal bleeding, while bladder irritation can lead to urinary urgency, frequency, and pain. Many of these side effects go away after treatments are completed, but some, like sexual problems and some degree of rectal and/or bladder irritation, may be permanent.

Late effects include increased risk of bowel obstruction and fractures in the bone at the base of the spine (the sacrum). In addition, radiation to the pelvic area may damage the ovaries, causing infertility; fertility counseling prior to treatment is recommended for women for whom this is a concern. Radiation also increases the risk of developing second cancers in exposed areas.

Chemotherapy

The chemotherapy drugs most often used in the treatment of CRC are 5-fluorouracil (5-FU) capecitabine, oxaliplatin, and irinotecan. Side effects depend on the type and dosage of drugs and the length of treatment. Some side effects are temporary (e.g., hair loss), while others may persist after treatment (e.g., numbness in the hands or feet). Side effects from chemotherapy include:

- Fatigue
- Memory problems and other mental deficits (i.e., "chemobrain")
- Nausea and vomiting
- Diarrhea
- Loss of appetite
- Hair loss
- Swelling and rashes
- Mouth sores
- Numbness, tingling, or blistering of the hands and feet (most common with oxaliplatin)
- Cold intolerance

Some patients may experience low blood cell counts because chemotherapy can damage the blood-producing cells of the bone marrow. This can increase the chance of infection (due to a shortage of white blood cells), bleeding or bruising after minor cuts or injuries (due to a shortage of blood platelets), and fatigue (due to a shortage of red blood cells).

There are remedies for many of the temporary side effects of chemotherapy. For example, antiemetic drugs can prevent or reduce nausea and vomiting, and drugs known as growth factors can increase the white blood cell count.

Targeted therapy

Targeted therapy is a newer area of drug development resulting from increased understanding of the molecular changes involved in cancer occurrence. These drugs target specific molecules involved in tumor growth and progression and have different, often less severe side effects than conventional chemotherapy drugs.

Epidermal growth factor receptor (EGFR) inhibitors

These drugs work by slowing or stopping cancer cell growth and may cause skin-related side effects, such as:

- Acne-like rash
- Dry skin
- Itching
- Swelling or pain in the fingernails or toenails

EGFR inhibitors may also cause diarrhea, as well as fatigue.

Vascular endothelial growth factor (VEGF) inhibitors

These drugs work by preventing the formation of new blood vessels necessary for tumor growth. Some potential side effects include:

- Problems with bleeding (e.g., nose bleeds, wound healing)
- Feeling tired or weak
- Diarrhea
- High blood pressure
- Clots in the arteries or veins
- Kidney damage
- Hand-foot skin reaction
- Intestinal perforation (a hole in the bowel)

What Is the American Cancer Society Doing about Colorectal Cancer?

Research

CRC is an active area of scientific research; studies span the cancer continuum from prevention and early detection to treatment and beyond. The American Cancer Society is currently funding more than $27 million in CRC research, with $8.8 million awarded in 2015. Examples of projects in which researchers in the American Cancer Society Extramural Research program are engaged include:

- Creating a toolkit that will help health care systems nationwide increase their colorectal cancer screening rates
- Testing different health literacy interventions to increase colorectal cancer screening among low-income and underinsured populations
- Exploring why obesity increases the risk of colorectal cancer
- Looking into the feasibility of developing recommendations that will enable patients to alter their diet in an effort to reduce risk of colon cancer
- Investigating how to create a colon cancer vaccine
- Working to better understand the role of gut bacteria in colon health

Examples of CRC research projects conducted within the American Cancer Society Intramural Research program include:

- Monitoring disparities in CRC screening, including identifying medically underserved populations and evaluating initiatives to reduce screening disparities
- Exploring the mechanisms underlying CRC development, such as gene-environment interactions
- Analyzing disparities and emerging trends in population-based CRC incidence and mortality rates
- Investigating factors associated with survival following a CRC diagnosis
- Identifying the needs of CRC survivors as they transition from active treatment and back into the community care setting
- Developing population-based systems for monitoring cancer patient-reported quality of life and treatment-related side effects

Strategies to reach the 80% by 2018 nationwide goal

The 80% by 2018 initiative is a nationwide movement in which over 1,200 organizations have committed to substantially reducing colorectal cancer as a major public health problem. The goal of the initiative, which is led by the American Cancer Society, the Centers for Disease Control and Prevention (CDC), and the National Colorectal Cancer Roundtable, is to have 80% of adults age 50 and older screened for colorectal cancer by 2018. The American Cancer Society is committed to the 80% by 2018 goal as one of our major initiatives and is implementing several key strategies in support of this nationwide program, including playing a major role as convener and leader of the effort.

Notably, our 600-plus force of health systems staff is playing a crucial role by engaging and supporting key strategic partners – such as hospitals and health systems, community health centers, state health departments, corporate partners, payers and state and local coalitions – to encourage and support their commitment to increasing the number of individuals who are screened for colorectal cancer. Our staff works with these partners to assist them in implementing proven strategies that are known to increase CRC screening rates, such as implementing provider and patient reminders, helping providers assess and track their screening rates, implementing quality screening navigation, using the power of the provider recommendation, and using tested messages for priority audiences.

Additionally, the American Cancer Society works to unify and magnify effective communication to the public about the value of colorectal cancer screening through multiple channels, in order to move consumers to action. These activities occur throughout the year, but spike during Colorectal Cancer Awareness month in March, when we develop and implement targeted traditional media and social media strategies to motivate unscreened consumers to get screened. The American Cancer Society Cancer Action Network℠ (ACS CAN), which is our nonprofit, nonpartisan advocacy affiliate, supports the effort by working with legislators and policy makers on the federal and state level to improve access and reduce policy barriers to screening and treatment, including addressing the needs of the medically underserved. Finally, the American Cancer Society leads by example, encouraging our own staff and volunteers to be up to date with recommended cancer screening tests. Through these actions, we are working to leverage the energy of multiple and diverse partners to make history and achieve this remarkable public health goal.

Advocacy

Our nonprofit, nonpartisan advocacy affiliate, the American Cancer Society Cancer Action Network (ACS CAN is involved in advocacy efforts at both the federal and state levels that increase access to quality CRC screening, treatment, and care for all adults. In partnership with the American Cancer Society, the Centers for Disease Control and Prevention (CDC), and the National Colorectal Cancer Roundtable, as well as over 1,200 other organizations, ACS CAN hopes to reach the goal of screening 80 percent of adults ages 50 and older for CRC by 2018. The following are some of the efforts the American Cancer Society and ACS CAN are involved in to help reach that goal:

- Implementing the provisions in the Patient Protection and Affordable Care Act, more commonly referred to as the Affordable Care Act or ACA. The reforms in the ACA, which was signed into law in March 2010, represent a profound structural change in how insurance operates and how consumers and patients use the health insurance system. ACS CAN and the American Cancer Society have a significant impact at the federal and state levels through our advocacy work, which urges policy makers to implement the law to ensure that all Americans have access to evidence-based prevention, early detection, and treatment services critical to CRC patients. In particular, ACS CAN has advocated for expansion of Medicaid in all 50 states for those individuals up to 138% of the federal poverty level, as it was originally intended by the ACA. This would ensure that low-income, uninsured, and underinsured Americans will have access to the same CRC services as those in private and other public insurances.
- Advocating for clarification on ACA-required coverage of CRC screening modalities as recommended by the United States Preventive Services Task Force (USPSTF). This includes clarifying that there should be no cost sharing requirements for a colonoscopy that is ordered to complete the screening process following a positive CRC stool-based screening test (follow-up colonoscopy), cost sharing for short interval screening following the removal of adenomatous polyps during a screening colonoscopy, and other ambiguous coverage issues related to CRC screening.
- Supporting the work and maintaining funding for the CDC's Colorectal Cancer Control Program (CRCCP), which currently provides funding to 31 grantees across the US. The CRCCP's goal is to increase CRC screening rates in targeted populations by implementing evidence-based, system-level interventions through partnerships with health systems. The program provides grants for both population-based education and awareness campaigns and efforts to improve access to vital CRC screening tests and follow-up services for at-risk low-income, uninsured, and underinsured individuals between the ages of 50 and 75.
- Advocating for passage of the Removing Barriers to Colorectal Cancer Screening Act of 2017, which will ease the financial burden of people living on a fixed income by allowing Medicare beneficiaries to receive screenings without coinsurance, even when a polyp is removed. This legislation would help increase screening rates and reduce the incidence of CRC.

- Engaging governors, mayors, and state legislators to inform them about the 80% by 2018 initiative, urging them to help make CRC screening a priority. Specifically, ACS CAN is urging state and city governments to work across all sectors to increase screening rates by eliminating cost and access barriers to screening and by investing in or creating a state CRC screening and control program.

Sources of Statistics

New cancer cases. The estimated number of CRC cases in the US in 2017 was projected using a spatiotemporal model based on incidence data from 49 states and the District of Columbia for the years 1999 to 2013 that met the North American Association of Central Cancer Registries' (NAACCR's) high-quality data standards for incidence. For more information on this method, please see Zhu et al.[228]

Incidence rates. Incidence rates are defined as the number of people newly diagnosed with cancer during a given time period per 100,000 population at risk. CRC incidence rates for the US were calculated using case data from the Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute, the National Program of Cancer Registries of the Centers for Disease Control and Prevention, and NAACCR, and population data collected by the US Census Bureau. Incidence rates for Alaska Natives are based on cases reported by the Alaska Native Tumor Registry (ANTR) of the SEER Program; rates for American Indians excluding Alaska Natives are based on NAACCR County Health Service Delivery Area (CHSDA) county regions excluding the ANTR. Incidence rates were age adjusted to the 2000 US standard population and adjusted for delays in reporting when possible.

Estimated cancer deaths. The estimated number of CRC deaths in the US in 2017 was calculated by fitting the actual numbers of CRC deaths from 2000 through 2014 to a statistical model that forecasts the number of deaths three years ahead. The actual number of deaths was obtained from the National Center for Health Statistics (NCHS) at the Centers for Disease Control and Prevention. For more information on this method, please see Chen et al.[229]

Mortality rates. Mortality rates, or death rates, are defined as the number of people who die from cancer during a given time period per 100,000 population. Mortality rates are based on counts of cancer deaths compiled by NCHS and population data from the US Census Bureau. Death rates for Alaska Natives were based on deaths occurring in the Alaska CHSDA region. Due to data limitations, there may be some cross-contamination between rates for American Indians and Alaska Natives where they are presented separately. Death rates are age adjusted to the 2000 US standard population.

Survival. Relative and cause-specific (herein referred to as cancer-specific) survival rates were calculated using data from the SEER registries. Relative survival rates account for normal life expectancy by comparing overall survival among a group of cancer patients to that of people not diagnosed with cancer who are of the same age, race, and sex. Cancer-specific survival is the probability of not dying from a specific cancer (e.g., colorectal) within a specified time period following a diagnosis. Cancer-specific survival was used for rates by race and ethnicity because reliable estimates of normal life expectancy historically have not been available by Hispanic ethnicity or for Asians/Pacific Islanders and American Indians/Alaska Natives.

Screening. The prevalence of CRC screening among US adults was obtained from the National Health Interview Survey (NHIS) 2015 data file, obtained from NCHS, released in 2016 (cdc.gov/nchs/nhis.htm). The NHIS is a centralized survey conducted by the US Census Bureau that is designed to provide national prevalence estimates on health characteristics such as cancer screening behaviors. Data are collected through in-person interviews.

Prevalence data for CRC screening by state were from the 2014 Behavioral Risk Factor Surveillance System (BRFSS) public use data tapes, obtained from the National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention. The BRFSS was designed to provide state prevalence estimates of health behaviors and was conducted by state health departments. The BRFSS is a telephone survey, so prevalence estimates are limited to those adults who have a cellular phone or who live in a household with a residential telephone line. Prevalence rates are age adjusted to the 2000 US standard population.

Important note about estimated cases and deaths. The projected numbers of new cancer cases and deaths for the current year are model based. For this reason, we discourage the use of our estimates to track cancer trends. Age-standardized incidence and mortality rates are used to track cancer incidence and mortality trends.

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For more information, contact:
Rebecca Siegel, MPH;
Kimberly Miller, MPH
Ahmedin Jemal, DVM, PhD

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