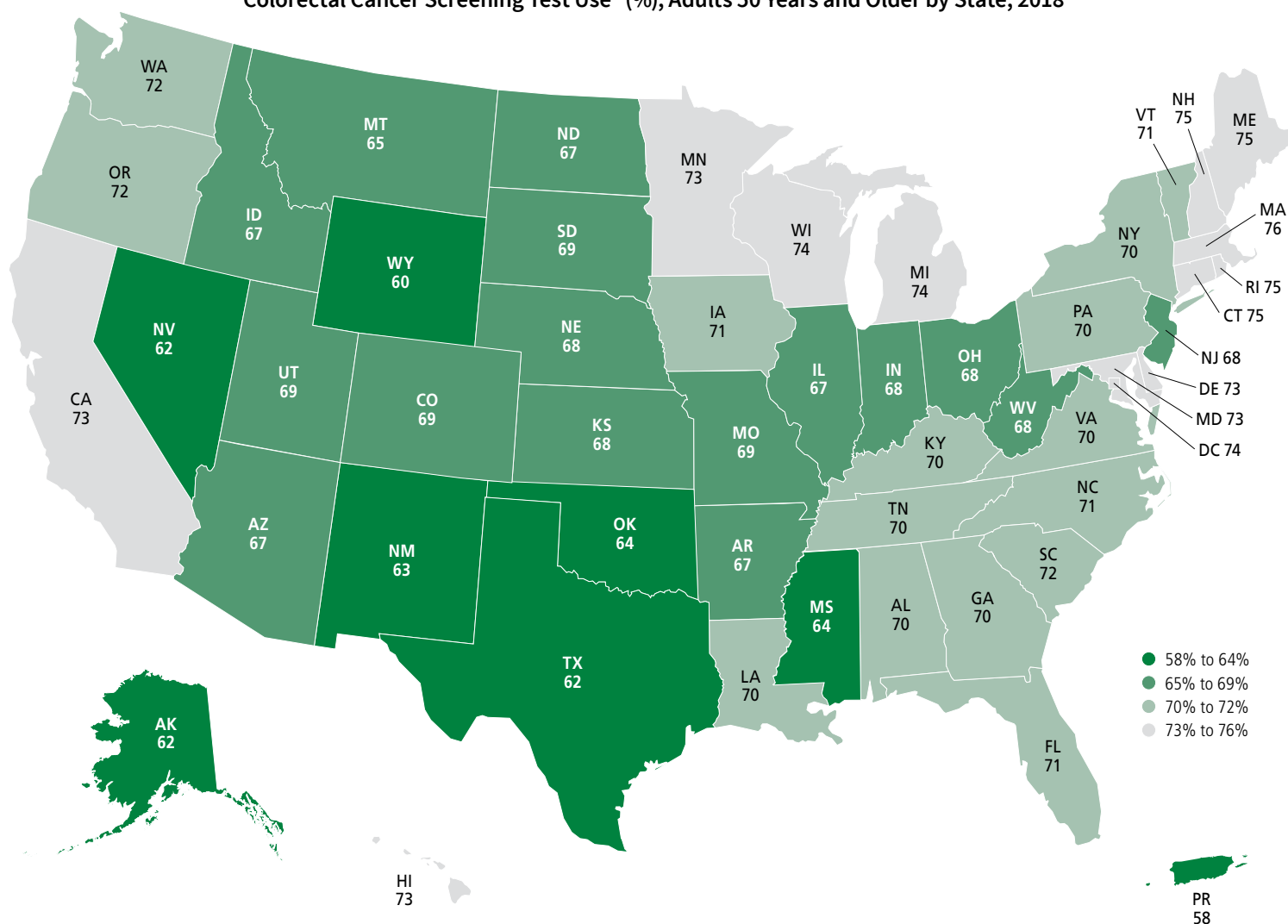


Colorectal Cancer Facts & Figures 2020-2022

Colorectal Cancer Screening Test Use* (%), Adults 50 Years and Older by State, 2018



*Blood stool test, sigmoidoscopy, or colonoscopy in the past 1, 5, and 10 years, respectively.

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

Source: Behavioral Risk Factors Surveillance System, 2018. See Sources of Statistics (page 32) for complete citation and more information.

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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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Colorectal Cancer

Basic Facts

What is colorectal cancer?

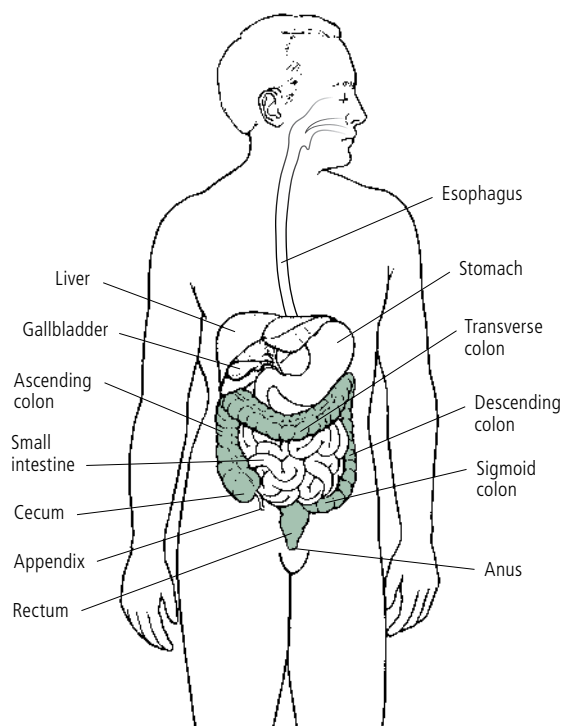
Cancer is a disease characterized by the unchecked division of abnormal cells. When this type of growth occurs in the colon or rectum, it is called colorectal cancer (CRC). The colon and rectum (colorectum), along with the anus, make up the large intestine, the final segment of the gastrointestinal (GI) system. The large intestine is sometimes called the large bowel, which is why CRC is sometimes referred to as bowel cancer. The function of the large intestine is to absorb water and electrolytes from food matter and eliminate feces. As depicted in Figure 1, 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 that is divided into 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* crosses the body from right to left, and is referred to collectively with the ascending colon as the proximal, or right, colon.
- The *descending colon* descends on the left side.
- The *sigmoid colon*, named for its “S” shape, is the final portion of the colon and is referred to collectively with the descending colon as the distal, or left, colon.

Waste 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 (2-3 centimeters or 1 inch). Despite their anatomic proximity, cancers in the anus are classified separately from those in the rectum because they usually originate from different cell types, and thus have different characteristics.

However, tumors within the colorectum also vary in their molecular, biological, and clinical features, and in their association with risk factors.^{1,2} For example, physical

Figure 1. Anatomy of the Gastrointestinal System



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inactivity is associated with increased risk of cancer in the colon, but not in the rectum. In addition, patients are more likely to be diagnosed with tumors in the proximal colon if they are older (versus younger), black (versus white), or female (versus male).^{3,4}

What is a colorectal polyp?

CRC almost always begins as a polyp, which is a noncancerous growth that develops in the mucosal layer (inner lining) of the colon or rectum. Polyps are common, detected in about half (including serrated polyps) of average-risk individuals 50 years of age or older undergoing colonoscopy, with higher prevalence in older age groups and among men compared to women.⁵ However, fewer than 10% of polyps are estimated to progress to invasive cancer,^{6,7} a process that usually occurs slowly over 10 to 20 years and is more likely as polyps increase in size.⁸⁻¹⁰

Polyps are classified based on their growth pattern as adenomatous (i.e., adenoma), which is the most common cancer precursor, or serrated, so-called because of its saw-toothed appearance under a microscope.¹¹ Serrated

polyps are further subdivided based on biological characteristics into sessile serrated polyps (SSPs), traditional serrated adenomas (TSAs), and hyperplastic polyps (HPs). Similar to adenomas, SSPs, TSAs, and large HPs are associated with an increased risk for CRC. SSPs are the most difficult to detect during colonoscopy because they are usually flat, covered with a mucous cap, and colored like the surrounding tissue. These features likely contribute to their role as precursors for a large proportion of cancers diagnosed prior to the next recommended colonoscopy (interval or post colonoscopy cancers).¹²

What are the stages of colorectal cancer?

Once a polyp progresses to cancer, it can grow into the wall of the colon or rectum where it may invade blood or lymph vessels that carry away cellular waste and fluid (Figure 2). Cancer cells typically spread first into nearby lymph nodes, which are bean-shaped structures that help fight infections. They can also be carried via blood vessels to other organs and tissues, such as the liver or lungs,¹³ or be shed directly into the peritoneum (membrane lining the abdomen).¹⁴ The spread of cancer cells to parts of the body distant from where the tumor started is called metastasis.

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 American Joint Committee on Cancer (AJCC) tumor, node, and metastasis (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:

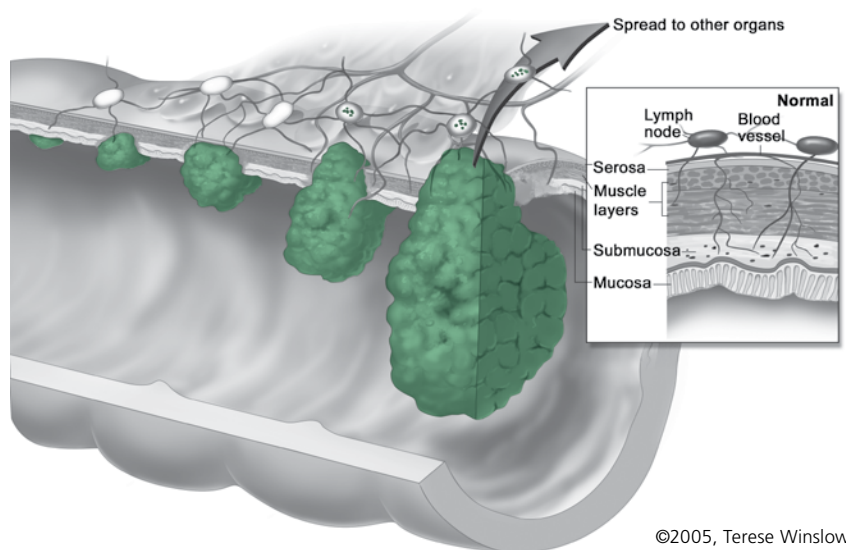
- **In situ:** Cancers that have not yet begun to invade the wall of the colon or rectum; these preinvasive lesions are not included in the cancer statistics provided in this report
- **Local:** Cancers that have grown into the wall of the colon or rectum, but have not extended through the wall into 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 one of the reasons screening is so important. As a tumor grows, it may bleed or block the intestine. The most common symptoms are:

- Bleeding from the rectum
- Blood in the stool or in the toilet after having a bowel movement
- Dark or black stools

Figure 2. Stages of Colorectal Cancer Growth



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- A change in bowel habits or the shape of the stool (e.g., more narrow than usual)
- Cramping, pain, or discomfort in the lower abdomen
- An urge to have a bowel movement when the bowel is empty
- Constipation or diarrhea that lasts for more than a few days

- Decreased appetite
- Unintentional weight loss

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. Timely evaluation of symptoms consistent with CRC is essential for all individuals, regardless of age, given the increasing incidence in young adults (see page 6).

Colorectal Cancer Occurrence

How many new cases and deaths are estimated to occur in 2020?

In 2020, there will be an estimated 104,610 new cases of colon cancer and 43,340 cases of rectal cancer diagnosed in the US (Table 1). Although the majority of CRCs are in adults ages 50 and older, 17,930 (12%) will be diagnosed in individuals younger than age 50, the equivalent of 49 new cases per day.

An estimated 53,200 people will die from CRC in 2020, including 3,640 men and women younger than age 50. 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.¹⁵ The high level of misclassification is partly attributed to the misconception among some that the terms colon cancer and colorectal

cancer are synonymous because of the widespread use of “colon cancer” to refer to both colon and rectal cancers in educational messaging. To help mitigate the issue and be more explicitly inclusive of rectal cancer patients, several organizations have publicly ended this practice.¹⁶ The ability to study these deaths separately is increasingly important given the steep rise in rectal cancer incidence among younger adults.¹⁷

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

As of January 1, 2019, there were 776,120 men and 768,650 women alive in the US with a history of CRC.¹⁸ About one-third (35%) of these individuals were diagnosed within the preceding 5 years, and more than half (56%) were ages 65-84 years. 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 4.4% of men (1 in 23) and 4.1% of women (1 in 25) will be diagnosed with CRC in their lifetime.¹⁹ Lifetime risk is similar in men and women despite higher incidence rates in men because women have longer life expectancy. In addition to sex, age and race/ethnicity also have a large influence on risk.

Table 1. Estimated Number of Colorectal Cancer Cases and Deaths in the US in 2020 by Age

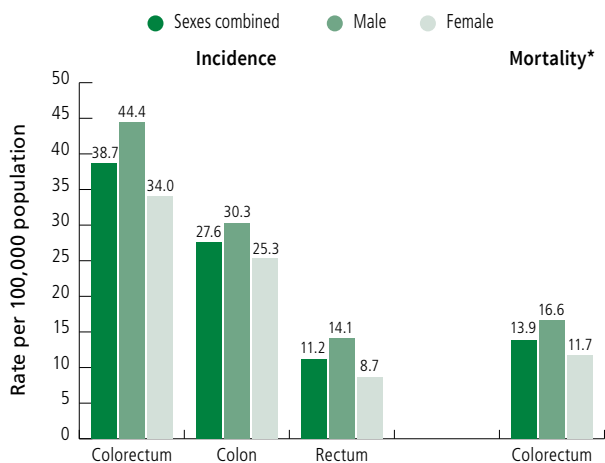
Age	Cases			Deaths*
	Colorectum	Colon	Rectum	Colorectum
0-49 years	17,930	11,540	6,390	3,640
50-64 years	50,010	32,290	17,720	13,380
65+ years	80,010	60,780	19,230	36,180
All ages	147,950	104,610	43,340	53,200

Estimates are rounded to the nearest 10 and exclude in situ carcinoma.

*Deaths for colon and rectal cancers are combined because a large number of rectal cancer deaths are misclassified as colon.

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Figure 3. Colorectal Cancer Incidence (2012-2016) and Mortality (2013-2017) Rates by Subsite and Sex, US



Rates are age adjusted to the 2000 US standard population. *Mortality rates by anatomic subsite are not available because a large number of rectal cancer deaths are misclassified as colon.

Sources: Incidence – North American Association of Central Cancer Registries (NAACCR), 2019. Mortality – National Center for Health Statistics (NCHS), 2019. ©2020, American Cancer Society, Inc., Surveillance Research

Sex

CRC incidence rates are 30% higher in men than in women, with a larger disparity for rectal cancer (60% higher) than for colon cancer (20% higher; Figure 3). As expected, women also have a lower prevalence of both

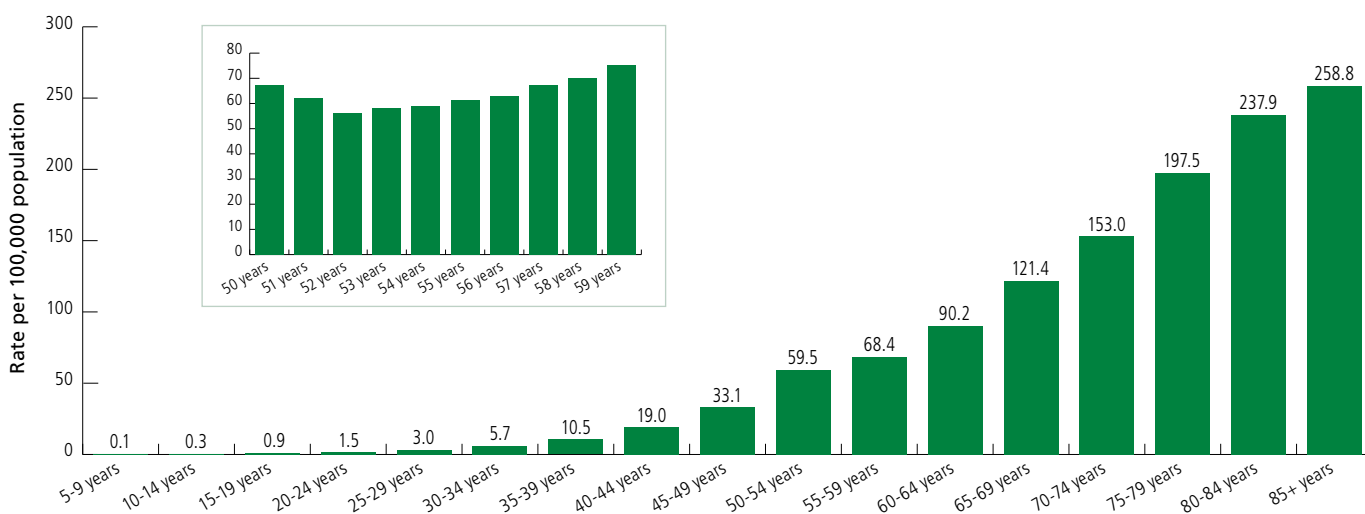
adenomas overall and of advanced adenomas.^{20, 21}

However, among individuals 50 and older, women are more likely than men to develop adenomas in the proximal colon,²⁰ which are less efficiently detected through screening.²² Gender disparities likely reflect differences in exposures to risk factors (e.g., cigarette smoking) and sex hormones, as well as complex interactions between these influences.²³ Notably, CRC incidence rates in men and women younger than 45 years are comparable.

Age

Like most types of cancer, the risk of CRC increases with age. For every subsequent 5-year age group, the incidence rate approximately doubles until age 50, and thereafter increases by about 30% (Figure 4). The exception is ages 50-54 years versus ages 55-59 years, for which there is only a 15% difference (60 versus 68 per 100,000, respectively), partly because the natural age-associated influence on risk is disrupted by first-time CRC screening in the younger age group. The screening effect is magnified in current rates by single year of age (Figure 4), which are actually higher in individuals ages 50-51 years than in those ages 52-55 years. This phenomenon is absent in incidence rates during the 1970s, prior to the uptake of screening.

Figure 4. Age-specific Colorectal Cancer Incidence Rates, US, 2012-2016



Source: Main figure: NAACCR, 2019. Inset: Surveillance, Epidemiology, and End Results (SEER) Program, 2019.

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The median age at CRC diagnosis is 66 years in men and 69 years in women, but is younger for rectal cancer (age 62 and 63, respectively) than for colon cancer (age 67 and 71, respectively).²⁴ CRC patients overall are increasingly younger, shifting from a median age of 72 years for diagnoses in the early 2000s to 66 years today.²⁵ This is because incidence is increasing in younger adults and declining in older age groups.¹⁷

Race/ethnicity

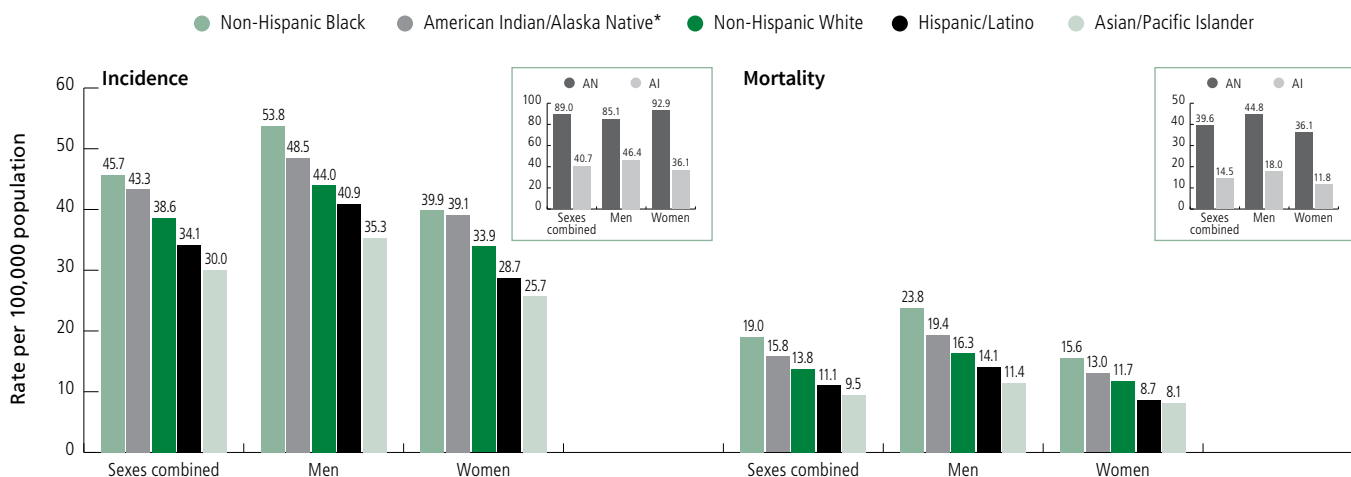
Among broadly defined racial and ethnic groups, CRC incidence and mortality are highest in non-Hispanic blacks (hereafter, blacks), followed closely by American Indians and Alaska Natives (AIANs), and lowest in Asians/Pacific Islanders (APIs; Figure 5). During 2012-2016, CRC incidence rates in blacks 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 almost 40% higher than those in NHWs and double those in APIs.

Reasons for racial/ethnic disparities in CRC are complex, but largely reflect differences in risk factor prevalence and health care access, both of which are related to socioeconomic status.²⁶ In 2018, the median family

income was \$41,361 among blacks compared to \$70,642 among NHWs, with 21% and 8%, respectively, living in poverty.²⁷ People with the lowest socioeconomic status are 40% more likely to be diagnosed with CRC than those with the highest socioeconomic status.²⁸ Close to half (44%) of this disparity is attributed to differences in the prevalence of risk factors associated with CRC (e.g., smoking, obesity)²⁹ and a similar proportion is due to differences in CRC screening.³⁰ After controlling for differences in risk factors, black individuals are no more likely than whites to develop adenomas or CRC, but are less likely to receive timely follow-up of a positive screening test and/or high-quality colonoscopy.^{31,32} Higher CRC mortality among blacks may also reflect a larger proportion of tumors in the proximal colon.³

Importantly, the broad racial and ethnic groups to which cancer statistics are generally limited mask striking differences within these heterogeneous populations. For example, although CRC incidence in API men overall is 25% lower than in NHW men, rates in Japanese men are 23% higher.³³ Even more alarming is the burden among Alaska Natives, who have the highest CRC incidence (89 per 100,000) and mortality (40 per 100,000) rates in the US, double those in blacks (46 and 19, respectively). CRC

Figure 5. Colorectal Cancer Incidence (2012-2016) and Mortality (2013-2017) Rates by Race/Ethnicity and Sex, US



AI: American Indian, excluding Alaska; AN: Alaska Native. Rates are age adjusted to the 2000 US standard population. *Statistics based on data from Purchased/Referred Care Delivery Area (PRCDA) counties. AI/AN incidence rates exclude data from Kansas and Minnesota. Incidence rates for Alaska Native men and women are not statistically significantly different.

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

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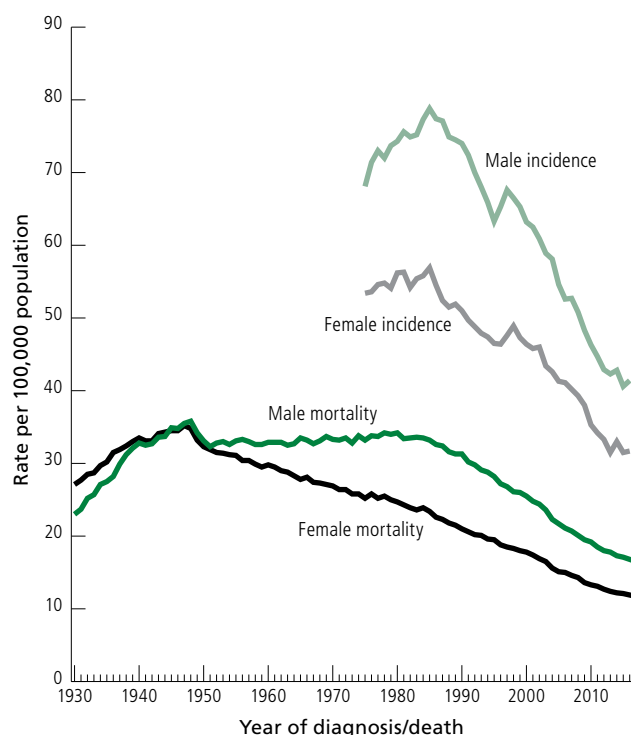
has been the most commonly diagnosed cancer in Alaska Natives since the early 1970s for reasons that are unknown, but may include a higher prevalence of CRC risk factors, such as a diet high in animal fat and low in fruits and vegetables, vitamin D deficiency, smoking, obesity, and diabetes.^{34, 35} In addition, Alaska Natives, particularly rural residents, have a high prevalence of *Helicobacter pylori* (*H. pylori*),³⁶ a bacteria associated with inflammation and cancer of the stomach that may also be associated with CRC risk.^{37, 38} Despite a disproportionately high burden of advanced adenomas among Alaska Natives,³⁹ the availability of endoscopic services in much of Alaska is inadequate.^{40, 41} A recent study found that Alaska had the lowest county-level CRC screening prevalence in the nation.⁴² In addition, the primary mode of screening at Indian Health Service facilities is stool testing, which has a limited capacity for cancer prevention and requires timely follow-up with colonoscopy for positive tests. Notably, AIANs are the only racial and ethnic group for which CRC mortality rates are not declining (see page 8).

How has colorectal cancer occurrence changed over time?

Incidence

Despite higher incidence in men than in women, trends over time are very similar by sex (Figure 6). CRC incidence rates increased from 1975 through the mid-1980s, but since have generally decreased. The decline prior to 2000 is attributed equally to changing patterns in risk factors (e.g., reductions in smoking) and the uptake of CRC screening.⁴³ However, the accelerated decline that began during the late 2000s is thought to predominantly reflect widespread uptake of CRC screening with colonoscopy, which increased among adults ≥ 50 years of age from 20% in 2000 to 61% in 2018.⁴⁴ There is about a decade of lag time between the detection and removal of precancerous polyps through screening and its reflection on CRC incidence rates.^{9, 45} Notably, however, declines in CRC incidence have decelerated in the most recent 5 data years (2012-2016), perhaps reflecting a slowing in first-time screening,⁴⁶ changing risk factors exposures, such as obesity, or a combination thereof.

Figure 6. Trends in Colorectal Cancer Incidence (1975-2016) and Mortality (1930-2017) Rates by Sex, US



Rates are age adjusted to the 2000 US standard population. Incidence rates are adjusted for delays in reporting and exclude appendix. Due to changes in International Classification of Diseases (ICD) coding, numerator information for mortality has changed over time.

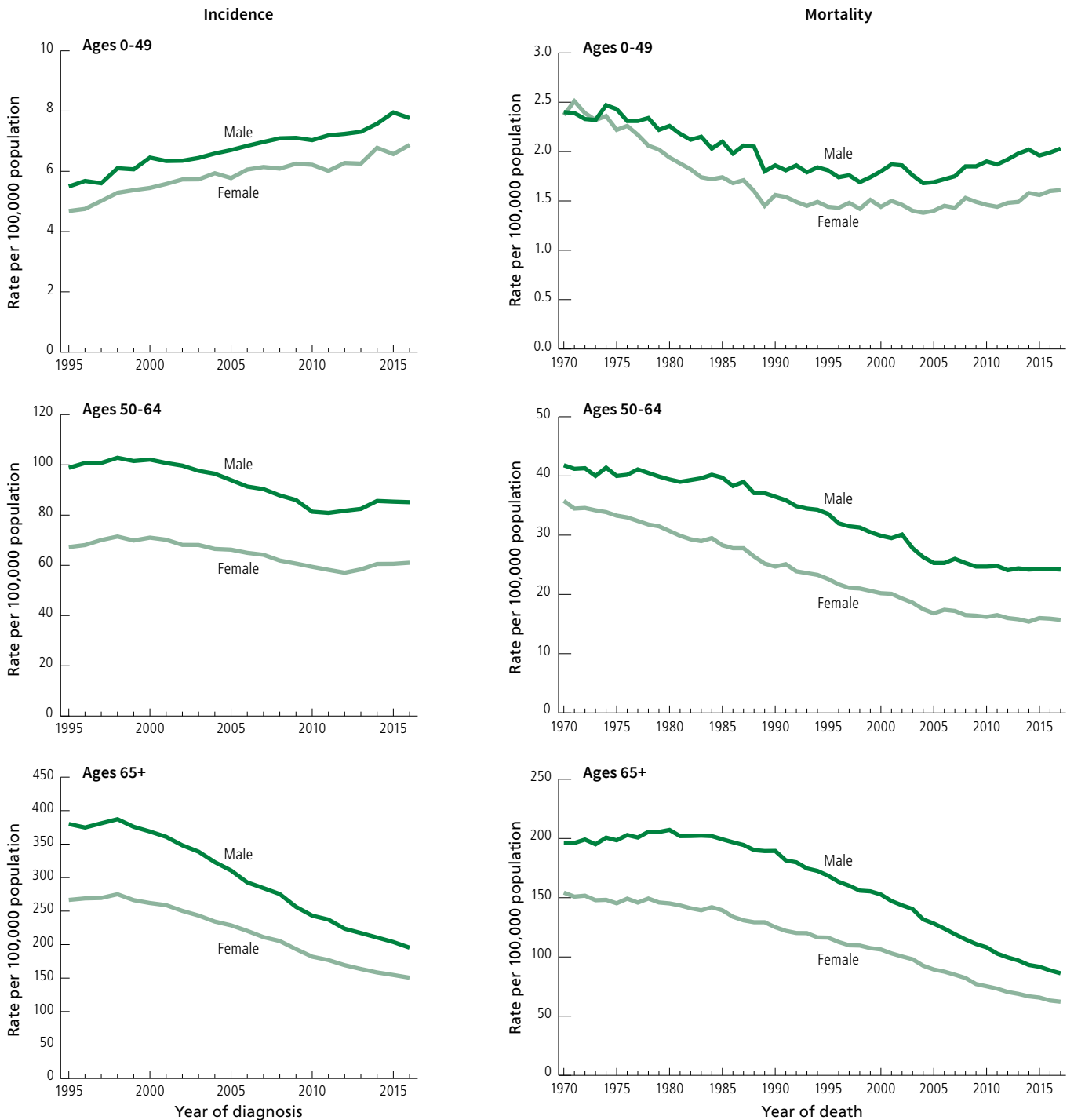
Source: Incidence – Surveillance, Epidemiology, and End Results (SEER) Program, 2019. Mortality – US Mortality Volumes 1930 to 1959, US; Mortality Data 1960-2017, NCHS, 2019.

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Age-specific incidence trends

CRC trends overall reflect the majority of cases that occur in older age groups, masking trends in young adults. CRC incidence rates have been increasing since the mid-1980s in adults ages 20-39 years and since the mid-1990s in adults ages 40-54 years, with younger age groups experiencing the steepest increase.¹⁷ This pattern is called a *birth cohort effect* because generations of individuals with higher incidence carry the elevated risk with them as they age. Indeed, after decades of decline, incidence rates have also begun to increase in ages 50-64 years. During the most recent five data years (2012-2016), incidence rates increased by 2.2% annually in individuals younger than 50 years and by 1% annually in those ages 50-64 years, a sharp contrast to declines of 3.3% per year in adults ages 65 and older (Figure 7). Although a similar incidence pattern

Figure 7. Trends in Colorectal Cancer Incidence (1995-2016) and Mortality (1970-2017) Rates by Age and Sex, US



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

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

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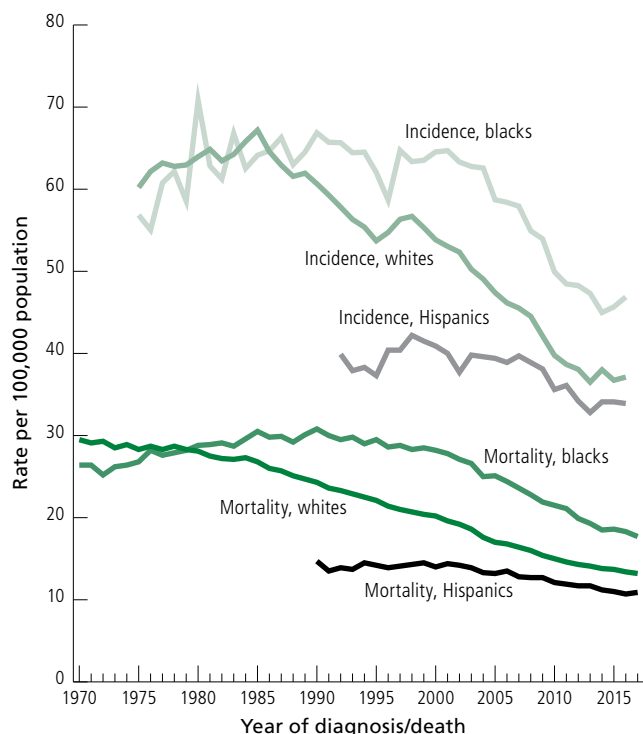
has been reported in many other high-income countries,⁴⁷ reasons for the increasing trend in younger age groups are unknown. It may reflect changes in established risk

factors, such as a more sedentary lifestyle and/or unfavorable dietary patterns, or other exposures whose association with CRC risk is yet unknown.

Racial/ethnic incidence trends

Historical cancer incidence data in the US are available only for the categories white, black, and other race. CRC incidence was similar in whites and blacks until the mid-1980s, when rates began declining in whites while remaining stable in blacks (Figure 8). These trends created a widening racial gap until the mid-2000s and likely reflect a combination of earlier access to and more rapid uptake of CRC screening tests among whites, as well as changing patterns in the prevalence of CRC risk factors.⁴⁸ Since the mid-2000s, CRC incidence rates decreased by about 1%-3% per year in all broadly defined racial/ethnic groups, although the pace appears to be slowing in recent years.²⁴ Notably, the steepest increase in early-onset CRC is among NHWs and AIANs.⁴⁹ As a result, incidence rates in NHWs ages 20-49 years are now equivalent to those in blacks (14.1 per 100,000 during 2015-2016), despite being 40% higher in blacks during 1995-1996.⁵⁰

Figure 8. Trends in Colorectal Cancer Incidence (1975-2016) and Mortality (1970-2017) Rates by Race, US



Rates are age adjusted to the 2000 US standard population. Incidence rates are adjusted for reporting delays and exclude appendix. White and black race are not mutually exclusive from Hispanic ethnicity.

Source: Incidence – SEER program, 2019. Mortality – NCHS, 2019.

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Mortality

CRC death rates have been decreasing since 1947 in women, but only since 1980 in men (Figure 6). This inconsistency likely reflects sex differences in incidence trends because of variable patterns in CRC risk factors, although population-based incidence data are not available prior to 1975. Trends over the past three decades are very similar by sex. Declines in mortality through 2000 are attributed to improvements in treatment (12%), changing patterns in CRC risk factors (35%), and screening (53%).⁴³ However, screening likely played an even larger role in more recent trends given its steep increase since 2000.⁵² Rapid declines in CRC death rates of about 3% per year from 2002 to 2012 slowed to 2% per year from 2012 to 2017.

Age-specific mortality trends

Like incidence, CRC mortality trends vary by age (Figure 7). Among older adults, decades of rapid declines have slowed, from 1% annually during 2004-2013 to 0.6% during 2013-2017 in those ages 50-64 years and from 3.3% to 2.6%, respectively, in those ages 65 and older. In contrast, CRC death rates have increased in individuals younger than 50 years of age by 1.3% per year since 2004.

Racial/ethnic mortality trends

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, then decreased sluggishly during the 1990s before matching the decline in whites in the early 2000s (Figure 8). As a result of these divergent trends, although CRC death rates in blacks were 10% lower than those in whites in the early 1970s, they were almost 50% higher in 2005. The widening racial disparity was largely driven by trends for distant-stage disease, which declined in whites while remaining stable in blacks through the mid-2000s.⁵³ About half of the racial disparity in mortality is attributed to a combination of less screening and lower stage-specific survival rates among blacks.³⁰ Since the early 2000s, CRC death rates have declined consistently by 1.8% per year in Hispanics and APIs and by 2.8% per year in blacks; however, rates were stable in AIANs during this time, and in whites declines slowed from 2.5% per year during

2005-2012 to 1.6% per year during 2012-2017. As a result, the black-white gap has slowly begun to narrow.

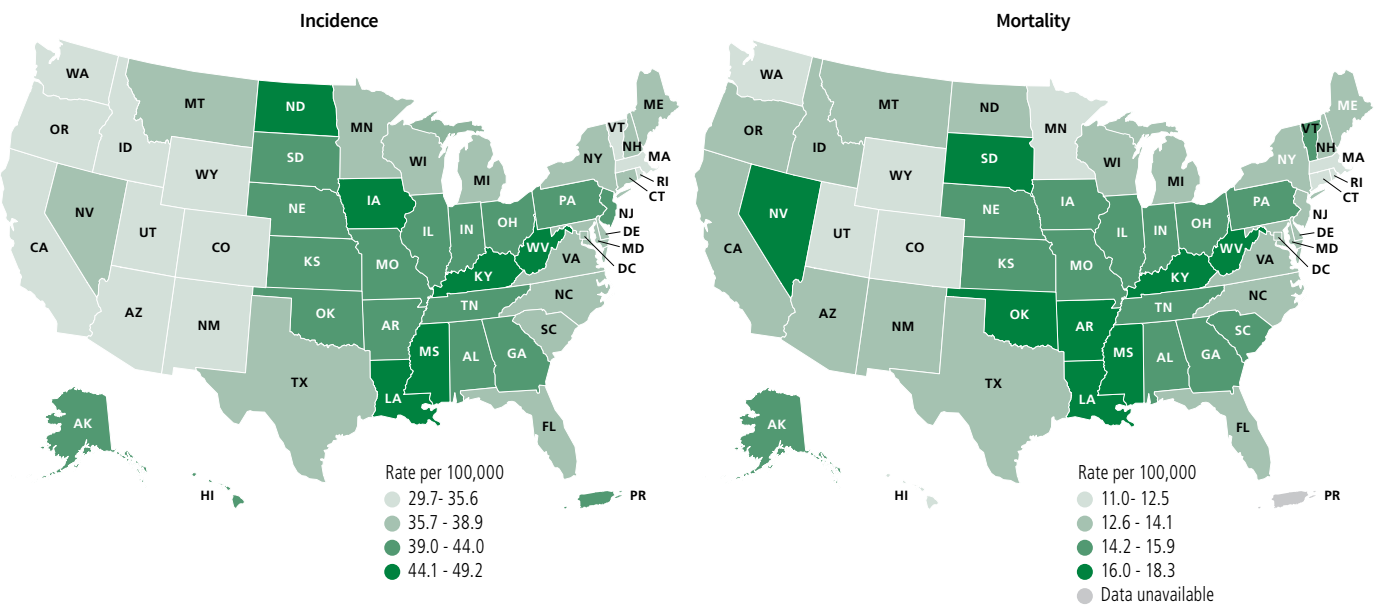
How does colorectal cancer occurrence vary by state?

The geographic pattern of CRC has changed dramatically over the past several decades. In contrast to the 1970s and 1980s, when the burden was highest across the Northeast and lowest in the South,⁵⁴ today it is highest in parts of the South, Midwest, and Appalachia and lowest in the West and Northeast. Current incidence rates range from 49 (per 100,000) in Kentucky to 30 in Utah, while death rates range from 18 in Mississippi and West Virginia to 11 in Connecticut and Utah (Figure 9). This shift is consistent with the racial and socioeconomic crossover in disease burden that occurred during the latter half of the 20th century because of changes in dietary and smoking patterns, as well as differences in access to early detection and high-quality treatment.⁵⁵ For example, CRC mortality among residents of poor counties was 20% lower than that among residents of affluent counties in the early 1970s, but is currently 30% to 40% higher.^{54,56} Geographic

patterns are generally similar for blacks and whites, particularly for mortality, highlighting the importance of socioeconomic status over race in cancer disparities.⁵⁷

Table 2 shows state-level incidence and death rates by race/ethnicity. Consistent with overall incidence, rates in NHWs and blacks are lowest in the West and highest in the South and Midwest. However, among Hispanics there is no clear pattern, perhaps reflecting geographic heterogeneity within this population in terms of place of birth and duration of residence, both of which influence CRC risk. Although data for AIANs are too sparse to provide by state, a recent study found that incidence rates for those living in Alaska (approximately 95 per 100,000) were more than two-fold higher than those living in the East and Southwest regions (30 to 40 per 100,000) of the US during 2010-2015.⁵⁸ Factors that may contribute to this disparity include differences in diet and the prevalence of obesity and smoking, as well as access to medical services, including screening. Among some more isolated groups (e.g., Alaska Natives), genetic differences may also play a role. (See page 5 and page 6 for more information about CRC in Alaska Natives.)

Figure 9. Colorectal Cancer Incidence (2012-2016) and Mortality (2013-2017) Rates by State, US



Nevada and the District of Columbia did not meet NAACCR high-quality incidence data standards for one or more years during 2012-2016. Incidence rates for the District of Columbia are based on data years 2012-2014. Rates are age adjusted to the 2000 standard population.
Sources: Incidence – NAACCR, 2019. Mortality – NCHS, 2019.

Table 2. Colorectal Cancer Incidence (2012-2016) and Mortality (2013-2017) Rates* by Race/Ethnicity and State, US

State	Incidence						Mortality					
	Men			Women			Men			Women		
	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	49.4	58.9	27.6	36.3	44.6	25.5	18.5	26.4	†	12.0	17.7	†
Alaska	37.0	†	†	33.1	†	†	13.3	†	†	11.5	†	†
Arizona	37.8	33.5	41.9	29.2	33.1	26.2	15.3	18.2	15.3	10.9	16.4	8.8
Arkansas	50.1	58.2	29.4	36.5	45.8	32.0	19.4	26.0	†	13.0	19.5	†
California	40.4	48.5	38.4	32.4	39.4	27.7	14.9	21.9	13.9	11.7	16.0	8.8
Colorado	35.5	48.8	44.7	29.5	34.6	33.5	13.4	19.5	16.8	10.4	11.5	11.3
Connecticut	40.8	46.1	49.4	31.5	36.1	32.9	13.0	16.7	12.8	9.5	10.9	7.1
Delaware	42.8	51.0	34.9	32.2	38.4	42.8	17.5	17.1	†	10.2	15.7	†
Dist. Of Columbia‡,§	29.2	61.7	†	27.8	44.6	†	7.9	26.9	†	7.3	17.8	†
Florida	41.3	48.9	43.5	31.3	36.7	31.6	15.5	20.6	14.6	10.9	14.0	9.6
Georgia	47.8	57.3	37.3	34.5	41.4	30.9	17.6	25.7	10.4	11.5	15.1	5.6
Hawaii	42.2	44.5	46.5	37.3	†	42.5	12.3	†	19.7	13.0	†	†
Idaho	39.4	†	31.4	32.3	†	24.0	15.4	†	11.9	11.4	†	†
Illinois	50.3	64.4	37.5	36.8	45.9	28.5	17.5	29.1	12.4	12.4	19.0	6.8
Indiana	48.7	52.6	35.7	38.0	41.4	31.1	18.0	24.4	10.5	12.9	17.0	6.3
Iowa	50.5	57.8	36.2	39.7	37.5	19.1	17.3	18.0	†	12.7	16.2	†
Kansas	45.2	56.6	44.8	34.9	38.5	24.7	17.8	25.3	16.8	12.2	16.4	8.9
Kentucky	57.8	59.4	32.8	42.4	45.0	21.5	20.2	24.6	†	13.9	16.7	†
Louisiana	51.6	65.8	28.9	36.9	47.8	22.3	18.5	28.5	†	13.0	18.2	†
Maine	41.9	†	†	33.8	†	†	14.7	†	†	11.4	†	†
Maryland	40.0	47.8	28.4	33.1	35.6	22.3	15.4	22.5	7.5	11.5	13.9	5.2
Massachusetts	39.6	44.6	33.1	31.6	33.4	23.2	14.1	16.3	8.5	10.5	11.4	7.5
Michigan	40.7	55.3	36.1	32.4	40.8	25.3	15.8	23.6	11.6	11.5	17.0	9.4
Minnesota	42.1	47.9	33.6	33.4	40.0	43.5	14.3	13.2	†	10.7	13.2	12.6
Mississippi	52.9	70.4	†	37.8	48.9	†	20.2	30.5	†	13.9	18.0	†
Missouri	47.6	56.6	29.8	35.1	41.8	23.7	17.3	26.1	†	12.0	16.1	†
Montana	42.1	†	63.0	32.2	†	†	15.5	†	†	10.6	†	†
Nebraska	49.0	70.8	36.9	37.5	38.5	33.9	17.5	27.8	†	12.5	20.7	†
Nevada†	42.3	47.1	35.2	33.5	33.3	25.5	19.9	30.4	13.6	14.9	17.0	9.1
New Hampshire	42.2	†	†	33.2	†	†	14.1	†	†	11.8	†	†
New Jersey	48.1	54.1	43.8	36.9	41.5	32.9	17.1	24.2	12.4	12.4	14.5	8.1
New Mexico	33.7	32.0	42.5	27.8	32.3	30.8	14.7	†	18.8	10.5	†	12.1
New York	44.8	50.7	43.6	34.8	36.6	29.1	15.3	18.2	13.6	11.3	13.7	8.2
North Carolina	41.7	51.6	27.8	32.0	36.3	24.2	15.3	23.2	6.4	10.6	14.8	6.0
North Dakota	51.9	†	†	36.8	†	†	16.5	†	†	11.0	†	†
Ohio	47.1	48.1	33.0	36.2	37.3	21.1	18.2	23.2	7.4	13.0	15.8	7.3
Oklahoma	46.8	54.6	37.3	35.2	40.6	33.0	20.3	28.4	14.1	13.7	15.6	6.7
Oregon	38.6	40.3	35.8	30.6	31.4	29.0	15.3	21.0	11.2	11.6	†	6.2
Pennsylvania	48.5	52.7	40.3	36.0	41.3	26.9	17.6	23.4	13.5	12.3	15.4	9.0
Rhode Island	38.5	35.7	35.3	31.4	25.2	23.0	14.9	†	†	11.5	†	†
South Carolina	42.5	54.5	29.0	32.4	37.3	30.4	16.0	24.8	†	11.1	14.9	†
South Dakota	46.4	†	†	36.2	†	†	19.5	†	†	12.5	†	†
Tennessee	45.7	56.9	21.4	35.2	41.4	17.4	17.7	28.3	†	12.5	18.0	†
Texas	44.5	56.4	46.0	32.1	40.9	28.0	17.2	26.6	17.2	11.4	16.3	8.9
Utah	32.9	58.7	38.7	25.6	†	32.2	12.7	†	12.5	9.6	†	9.1
Vermont	37.3	†	†	33.2	†	†	16.4	†	†	13.9	†	†
Virginia	39.2	49.4	25.5	31.3	38.2	24.0	15.8	24.4	9.1	10.9	15.2	6.3
Washington	39.2	42.6	36.0	32.5	33.8	26.1	14.7	17.1	9.5	10.9	13.3	6.5
West Virginia	52.0	50.1	†	41.5	43.6	†	20.4	30.6	†	15.8	15.8	†
Wisconsin	41.5	64.0	28.9	31.9	43.7	25.6	15.0	24.7	11.7	11.0	16.9	6.8
Wyoming	36.9	†	41.7	28.6	†	32.6	14.1	†	†	10.0	†	†
US	44.0	53.8	40.8	33.9	39.9	28.7	16.3	23.8	14.1	11.7	15.6	8.7

*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. ‡Incidence data for these states are not included in US combined incidence rates because data did not meet inclusion standards for all years during 2012-2016 according to the North American Association of Central Cancer Registries (NAACCR). §Rates are based on cases diagnosed during 2012-2014.

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

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Colorectal cancer survival

The relative survival rate for CRC is 64% at 5 years following diagnosis and 58% at 10 years.⁵⁹ The most important predictor of CRC survival is stage at diagnosis. The 5-year survival rate is 90% for the 39% of patients diagnosed with localized-stage disease, but declines to 71% and 14% for those diagnosed with regional and distant stages, respectively (Figure 10 and Figure 11). Rectal cancer is diagnosed at a localized stage slightly more often than colon cancer, 41% versus 38%, likely due to the earlier appearance of symptoms and partly explaining the higher overall 5-year relative survival (67% versus 63%). Factors associated with advanced-stage CRC diagnosis include low socioeconomic status, black race, and young age.^{60, 61}

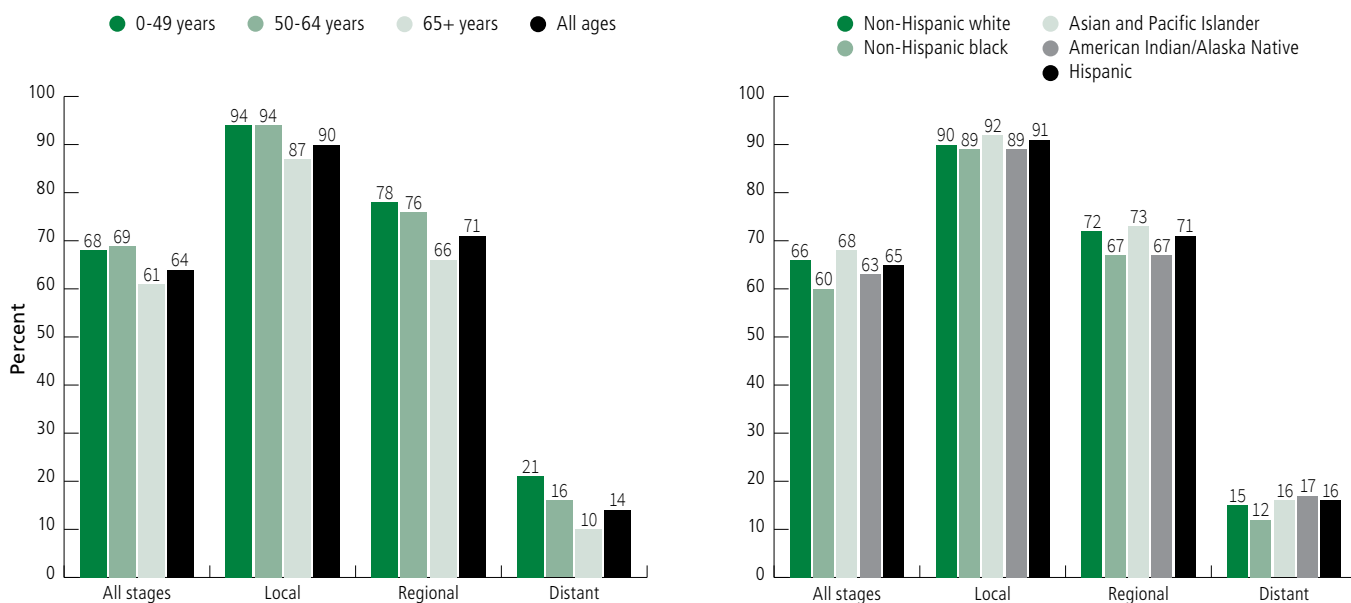
Factors associated with CRC survival in addition to stage include age at diagnosis, the presence of other illnesses, and other tumor and patient characteristics, such as race/ethnicity and socioeconomic status.⁶² For reasons that are not explained by tumor differences or other known factors, women are slightly more likely than men to survive after a CRC diagnosis.⁶³ There is some evidence

that patients with tumors located in the proximal colon have lower survival rates than those with tumors in the distal colon,⁶⁴ but this association may be confined to distant-stage diagnoses.⁶⁵

Age

Although CRC patients younger than age 50 have higher 5-year relative survival rates than their older counterparts for every stage of diagnosis (Figure 10), overall survival among patients younger than age 50 (68%) is similar to that in ages 50-64 years (69%) because of a later stage at diagnosis. Approximately 26% of CRCs are diagnosed at a distant stage among patients younger than age 50, compared to 23% in ages 50-64 years and 19% among those ages 65 and older (Figure 11). Despite having the highest proportion of early-stage diagnoses, however, individuals ages 65 and older have the lowest overall 5-year relative survival (61%) because their stage advantage is outweighed by age-related disadvantages, such as additional health issues.

Figure 10. Colorectal Cancer Five-year Survival (%) by Age and Race/Ethnicity, 2009-2015

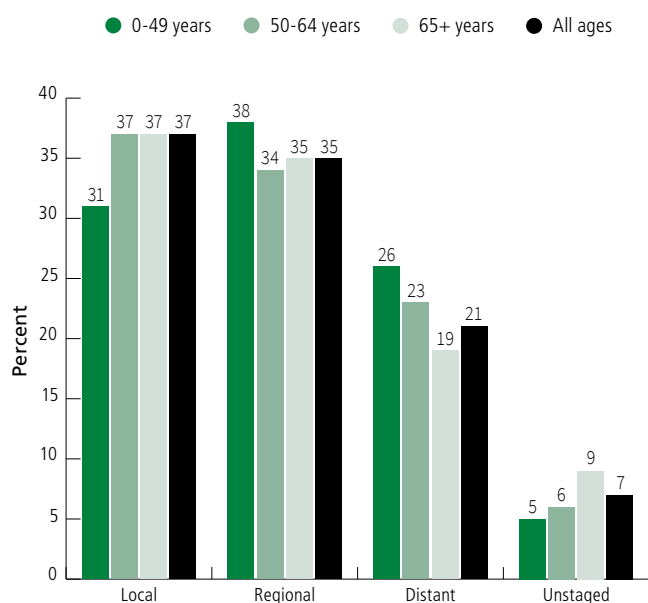


*Cause-specific survival rates are the probability of not dying from colorectal cancer within 5 years of diagnosis. Rates are based on cases diagnosed from 2009 to 2015, all followed through 2016. Rates for American Indians/Alaska Natives are based on small case numbers, particularly for distant-stage disease.

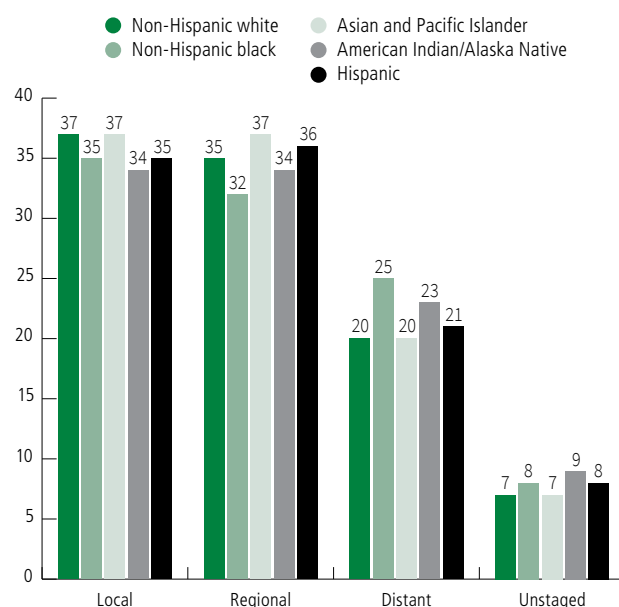
Source: SEER Program, 2019.

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Figure 11. Colorectal Cancer Stage Distribution (%) by Age and Race/Ethnicity, 2012-2016



Source: NAACCR, 2019.



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Race/ethnicity

Outcomes among racial/ethnic minorities are described in terms of cause-specific survival because life expectancy data for minority groups are inadequate to calculate relative survival. The highest CRC survival rates are for APIs (68%) and the lowest are for blacks (60%; [Figure 10](#)), one-quarter of whom are diagnosed with distant-stage disease ([Figure 11](#)). As described earlier, disparities in CRC outcomes are largely driven by socioeconomic inequalities that result in differences in access to early detection and receipt of timely, high-quality treatment.^{61,66} Access to care is directly related to stage at diagnosis, which plays the largest role in racial/ethnic survival disparities.⁶⁷ Notably, when CRC is diagnosed at localized stage, 5-year survival is relatively similar (89%-92%) across racial/ethnic groups.

A recent nationwide study found that more than one-half of the black-white survival disparity is explained by differences in insurance status and one-quarter is due to differences in tumor characteristics (e.g., grade, location).³ There is also compelling evidence that black patients are less likely to receive prompt follow-up after an abnormal CRC screening test³² and appropriate surgery, adjuvant

chemotherapy, and radiation treatments.^{3,68-70} Although a recent study found no evidence of treatment delays in an equal-access health system,⁷¹ equal cancer treatment does not eliminate the racial survival disparity.^{72,73} Thus, equity in care across the cancer continuum, from prevention to early detection to clinical-trial participation and individualized treatment, is necessary to eliminate these disparities.⁷⁴

Changes over time

The 5-year relative survival rate for CRC has increased moderately from 50% in the mid-1970s to 64% during 2009-2015.²⁴ However, recent advances in the treatment of metastatic disease, including improved surgical methods and the development of targeted therapies,⁷⁵⁻⁷⁷ have rapidly extended survival for these patients. For example, the 2-year relative survival rate for distant-stage disease increased from 21% for patients diagnosed during the mid-1990s to 37% for those diagnosed during 2009-2015, with a larger jump for rectal cancer (22% to 41%) than for colon cancer (21% to 36%). Although progress is evident across race and age,⁷⁸ gains are most prominent among white and non-elderly patients.⁷⁹

Colorectal Cancer Risk Factors

In the United States, more than half (55%) of all CRCs are attributable to lifestyle factors, including an unhealthy diet, insufficient physical activity, high alcohol consumption, and smoking.⁸⁰ These behaviors are traditionally associated with high-income countries, where CRC rates are highest. On a global scale, increasing CRC incidence is considered a marker of economic transition.⁸¹ Importantly, however, numerous studies have shown that people with healthy lifestyle behaviors have a 27% to 52% lower risk of CRC compared to those without these behaviors.⁸²

Nonmodifiable factors that increase risk are related to heredity and medical history, including a personal or family history of CRC or adenomas (precancerous polyps) and a personal history of long-term chronic inflammatory bowel disease. Most people at increased risk because of a medical or family history should begin CRC screening before age 45. (For more information on CRC screening guidelines, please see page 30.) 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, making this one of the most important and actionable risk factors.⁸³⁻⁸⁵ 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, with higher risk for diagnosis before age 50 and/or multiple affected relatives (Table 3).⁸⁴ However, a history of CRC among more distant relatives also increases risk,⁸⁶ as does a family history (first- or second-degree relatives) of adenomas.⁸⁷ Much of the CRC clustered in families is thought to reflect interactions between lifestyle factors and the cumulative effect of relatively common genetic variations that increase disease risk, referred to as high prevalence/low penetrance mutations.⁸⁸

Identification of families with a history of CRC, especially high-burden families with undiagnosed genetic syndromes (i.e., low prevalence/high penetrance mutations, described

below), offers substantial opportunity to lessen cancer incidence and mortality through increased surveillance with colonoscopy. However, patient family history in medical records continues to be incomplete. One study found that less than half of primary care physicians documented information about family members other than first-degree relatives, and age at cancer diagnosis was rarely collected.⁸⁹ Another study found that only 22% of CRC patient medical records had family history information sufficient to identify individuals who should be referred for genetic counseling and/or testing.⁹⁰

Table 3. Relative Risks for Established Colorectal Cancer Risk Factors

	Relative risk*
Factors that increase risk:	
Heredity and medical history	
Family history ⁸⁴	
CRC	
1 or more first-degree relatives	2.2
1 or more first-degree relatives diagnosed before age 50	3.6
2 or more first-degree relatives	4.0
1 or more second-degree relatives	1.7
Adenoma	
1 or more first-degree relatives	2.0
Inflammatory bowel disease ¹¹⁵	1.7
Type 2 diabetes ¹²⁴	
Male	1.4
Female	1.2†
Modifiable factors	
Heavy alcohol (daily average >3 drinks) ¹⁹⁵	1.3
Obesity (body mass index ≥ 30 kg/m ²) ¹⁴⁶	1.3
Colon, male	1.5
Colon, female	1.1
Rectum, male	1.3
Rectum, female	1.0†
Red meat (100 g/day) ¹⁶⁶	1.1
Processed meat (50 g/day) ¹⁶⁶	1.2
Smoking ¹⁹⁰	
Current vs. never	1.5
Former vs. never	1.2
Factors that decrease risk:	
Physical activity ¹³⁸	0.7
Dairy (400 g/day) ¹⁶⁶	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.
†Relative risk was not statistically significant.

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Hereditary syndromes

A recent study found that 5% of CRC patients have an inherited gene mutation (germline mutation) associated with a known high-risk hereditary condition, and an additional 5% have mutations associated with moderately increased risk.⁹¹

Lynch syndrome

The most common hereditary risk factor for CRC is Lynch syndrome, which accounts for about 3% of all CRCs.⁹¹ People with Lynch syndrome are also at increased risk for many other cancers, including endometrial, ovarian, small intestine, stomach, urinary bladder, and female breast.⁹² These individuals have a mutation in certain genes that hinders the cell's ability to correct errors introduced during DNA replication. These mistakes result in additional mutations that can ultimately lead to cancer,⁹³ the likelihood of which is dependent on which gene is affected. Among the 80% of Lynch syndrome patients with high-risk gene (*MLH1* or *MSH2*) mutations, 19% to 25% will develop CRC by age 50 and 40% will develop the disease by age 70.⁹⁴ The median age at CRC diagnosis among Lynch syndrome patients is 61 years of age,⁹⁵ and 8% of CRCs that occur in adults younger than age 50 are caused by Lynch syndrome.⁹⁶

Although an estimated 1.2 million Americans (1 in 279) have Lynch syndrome,⁹⁷ the vast majority are undiagnosed because identification is dependent on a cancer diagnosis. However, there is increasing recognition of the need for a more proactive approach because rigorous colonoscopy surveillance leads to early-stage diagnosis and high survival in Lynch syndrome patients.⁹⁸ Numerous organizations, including the National Comprehensive Cancer Network and American Society for Clinical Oncology, recommend testing for Lynch syndrome in all patients with colorectal or endometrial cancer.^{99, 100} Although implementation of universal testing has been slow in the community hospital setting,¹⁰¹ most major public and private insurers cover the screening.¹⁰²

Polyposis syndromes

Polyposis syndromes are another type of hereditary condition associated with increased CRC risk, the most common of which is familial adenomatous polyposis

(FAP), which accounts for about 1% of all CRCs.⁹¹ FAP is characterized by the development of up to thousands of colorectal polyps in the second and third decade of life. It is typically caused by a mutation in the adenomatous polyposis coli (APC) gene, which normally prevents uncontrolled cell growth and division.¹⁰³ These mutations are usually inherited, but occur spontaneously in 10% to 25% of affected people so there is not always a family history of the condition.¹⁰⁴ Disease severity ranges from severe (classic FAP) to mild (attenuated FAP), with the latter associated with later age at onset and fewer polyps (<100), but still high lifetime CRC risk.¹⁰⁵ Surgery is the standard method of cancer prevention for people with FAP once adenoma development is beyond the control of colonoscopy. MUTYH-associated polyposis (MAP) is a more recently recognized syndrome with large variability in clinical features, but in which patients typically develop a similar number of polyps as those with attenuated FAP.¹⁰³ Other colorectal polyposis syndromes include Peutz-Jeghers syndrome, juvenile polyposis syndrome, and serrated polyposis syndrome.¹⁰⁶

BRCA1 and *BRCA2*

Approximately 1% of CRC patients have heritable mutations in the breast cancer susceptibility genes *BRCA1* and/or *BRCA2*,⁹¹ which are among the most well-studied cancer predisposing genes. A gene panel study of CRC patients younger than age 50 also found a 1% prevalence.⁹⁶ In addition to breast cancer, these mutations confer increased risk for cancers of the ovary, prostate, and pancreas.¹⁰⁷ Although their influence on CRC risk is not well studied, a recent review reported an association limited to *BRCA1* mutation carriers, who have about a 50% increased risk of the disease compared to individuals without the mutation.¹⁰⁸

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,¹⁰⁹ however, only 2% of patients will develop a second primary CRC.¹¹⁰ A history of adenomatous polyps also increases CRC risk, especially multiple or large polyps.¹¹¹

CRC risk is also increased among individuals with a history of other cancer types because of the carcinogenic effects of some treatments. Examples include childhood cancer survivors, especially those who received pelvic or abdominal or total-body radiotherapy, or certain drugs (e.g., cisplatin, procarbazine);¹¹² men treated with radiotherapy for prostate cancer;¹¹³ and men treated with platinum-containing chemotherapy for testicular cancer.¹¹⁴

Chronic inflammatory bowel disease

Chronic inflammatory bowel disease (IBD) is a lifelong condition, usually diagnosed in early adulthood, in which the gastrointestinal tract is inflamed over a long period of time. People with IBD have almost double the risk of developing CRC compared to people in the general population.¹¹⁵ The most common forms of IBD are ulcerative colitis and Crohn disease. Cancer risk increases with the extent, duration, and severity of disease,^{115, 116} but has decreased over time, likely due to the increased use of medications to control inflammation and screening surveillance to detect premalignant lesions.¹¹⁷ Although the efficacy of anti-inflammatory drugs for limiting IBD-related cancer occurrence remains unclear, two recent meta-analyses reported reduced CRC risk of 33% to 50% among individuals with ulcerative colitis, but no effect for those with Crohn disease.^{118, 119} CRC patients with IBD are about 15 years younger than those without IBD and 70% more likely to die from their cancer after accounting for age and stage at diagnosis.¹²⁰ IBD has been diagnosed in an estimated 3.1 million Americans and is most common among non-Hispanic whites, women, and those with the least education.¹²¹ Although surveillance data in the US are sparse, prevalence appears to have increased in recent years.¹²²

Diabetes

People who have type 2 (adult onset) diabetes have a slightly increased risk of CRC that appears stronger in men than in women.^{123, 124} The association between type 2 diabetes and CRC remains even after accounting for shared risk factors (physical activity, body mass index, and waist circumference).¹²⁵ Although some studies suggest that metformin, a drug commonly used to lower blood glucose levels in diabetic patients, independently

reduces CRC incidence,¹²⁶⁻¹³⁰ a randomized controlled trial found no association.¹³¹ CRC patients with diabetes are no more likely to die from their cancer than those without diabetes, despite higher rates of cancer recurrence, as well as mortality from other causes.¹³²

The prevalence of Americans with a history of diabetes has more than doubled over the past two decades.¹³³ Although type 2 diabetes is rare among children and adolescents (ages 0-19 years), incidence rates increased by 7% per year between 2002 and 2012, from 9.0 cases per 100,000 in 2002-2003 to 12.5 in 2011-2012.¹³⁴ According to the Centers for Disease Control and Prevention, 30.3 million people (9.4% of the population) were diabetic in 2017, including 7.2 million who were undiagnosed and one-quarter of whom were 65 years of age and older.¹³⁵

H. pylori

Results from earlier studies evaluating the link between infection with *H. pylori*, a bacteria strongly associated with excess stomach cancer risk, and CRC occurrence were inconsistent.¹³⁶ However, this may be because the association is confined to specific subtypes of the bacterium. A recent large study found that increased CRC risk is limited to individuals with a history of infection with particular *H. pylori* strains, and that this association is strongest among black Americans.¹³⁷

Modifiable 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 about a 25% lower risk of developing both proximal and distal colon tumors than the least active people.^{138, 139} Being physically active from a young age may further lower risk.¹⁴⁰ Likewise, 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.¹⁴¹ However, sedentary people who become active later in life may reduce their risk.¹⁴² Additionally, people who were more physically active before a CRC diagnosis are less likely to die from the disease than those who were less active.¹⁴³ 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 to 300 minutes of moderate-intensity activity or 75 to 150 minutes of vigorous-intensity activity each week (or a combination of these), preferably spread throughout the week, and limit time spent sedentary in activities like watching television.

Overweight and obesity

Excess body weight increases the risk of CRC, even among those who are physically active.^{144, 145} Compared to people who are normal weight, obese men have about a 50% higher risk of colon cancer and a 25% higher risk of rectal cancer, whereas obese women have about a 10% increased risk of colon cancer and no increased risk of rectal cancer.¹⁴⁶ Excess risk is also associated with higher abdominal fat, measured by waist circumference or waist-to-hip ratio, and fat stored within the abdominal cavity, independent of body mass index and waist circumference.¹⁴⁷ Thus, abdominal fat specifically may be more important than overall body weight in influencing CRC risk.¹⁴⁸ The timing of exposure may also be a factor, with studies suggesting a stronger influence for excess body weight during adolescence and young adulthood among women, but later in life for men.¹⁴⁹ Higher body weight, even within the normal range, appears to increase risk of early-onset CRC (before age 50), at least among women.¹⁵⁰ In addition, high body mass index measured prior to diagnosis reduces the likelihood of CRC survival.^{147, 151} Excess body weight can have a negative impact on the proper functioning of many biochemical processes in the body (metabolic health), and studies indicate that poor metabolic health may be related to CRC incidence and survival independent of obesity.¹⁵²⁻¹⁵⁴

Diet

Differences in CRC incidence globally, as well as the relatively rapid changes in risk among immigrant populations in the United States, have long suggested that diet is linked to CRC occurrence.¹⁵⁵ Dietary patterns likely influence risk both indirectly, through excess calories and obesity, and directly through specific dietary elements. For example, diet has a large influence on the composition of the gut microbiome, which is the trillions

of microorganisms, including the 1,000+ different strains of bacteria, that inhabit the large intestine. High levels of specific bacteria in the microbiome are associated with CRC risk.^{156, 157} The microbiome is a very active area of research because it is thought to play a dual role in both preventing and promoting CRC and many other diseases through its influence on immune response and inflammation.¹⁵⁸⁻¹⁶² Diets with greater amounts of certain foods, such as refined carbohydrates, processed sugar, and red meat, have a higher potential to increase inflammation and are associated with increased CRC risk.¹⁶³

However, 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); 3) the strong link between dietary patterns and other health behaviors; and 4) a constantly changing food supply. The following is a summary of current scientific evidence for dietary elements linked to CRC:

Dairy/Calcium: Most studies find that calcium consumption from dairy foods and/or supplements is associated with a decreased risk of developing adenomas and CRC,¹⁶⁴⁻¹⁶⁶ although the mechanism remains unclear. Adequate calcium intake (approximately 700-1,000 mg/day) seems to confer protection, with limited additional benefit for higher consumption.¹⁶⁴ The relationship appears to require years of follow-up to observe;¹⁶⁷ be confined to cancers in the distal colon/rectum and particular molecular subtypes;^{168, 169} and perhaps be moderated by other dietary factors.^{164, 170}

Whole grains/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 and protective associations are weak.¹⁶⁴ The evidence for whole grains specifically is stronger than for overall fiber; two recent meta-analyses found that CRC risk was decreased by about 5% for every 30 grams/day of whole-grain intake.^{166, 171} Importantly, the

overall health benefit of a diet high in whole grains is clear,¹⁷² and the American Cancer Society and the World Cancer Research Fund both advocate a diet high in plant foods, including whole grains, fruits, and vegetables for the prevention of cancer and other diseases.^{173, 174}

Folate: Folate intake, consumed through diet or supplements, appears to have a complex relationship with CRC risk, potentially promoting growth of preexisting tumors, while inhibiting formation of new tumors in healthy tissue.¹⁶⁴ 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 6).¹⁷⁵ However, this hypothesis is not supported by an analysis of data from randomized controlled trials that found no association between five years of folic acid supplementation and CRC risk.¹⁷⁶ Additional prospective studies conducted post-fortification found that the highest level of folate intake was associated with reduced risk of CRC.¹⁷⁷

Fruits and vegetables: Results from numerous studies specifically evaluating the association between fruit and vegetable intake and CRC risk are inconsistent.¹⁶⁴ Two recent meta-analyses found no relationship for fruit and a possible slightly reduced risk for the highest versus lowest vegetable consumption.^{166, 171} Any protective effect appears to be for moderate compared to low consumption, with high consumption providing little additional benefit.^{178, 179}

Red and processed meat: Consumption of red and/or processed meat increases the risk of CRC, with a stronger association for colon cancer than rectal cancer and for processed meat than red meat.^{166, 180} A recent synthesis of evidence for the World Cancer Research Fund found that the risk of CRC is increased by 18% for every 50 grams/day of processed meat (approximately 2 slices of lunchmeat) and by 12% for every 100 grams/day of red meat (marginally significant).¹⁶⁶ 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.¹⁸¹ 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.¹⁸² Although there is concern about rising consumption of processed foods overall, intake of processed meat appears to have remained stable over the past two decades.¹⁸³

Vitamin D: Higher blood levels of vitamin D may be associated with lower risk of CRC, although research findings remain inconsistent.¹⁶⁴ Clinical trials have not found an association between daily supplementation with vitamin D and risk of adenomas¹⁶⁷ or CRC.¹⁸⁴ However, a recent study of pooled data from 17 cohort studies indicated that higher blood levels of vitamin D (25[OH]D up to 100 nmol/L) were associated with reduced CRC risk among women, and deficiency was associated with a 37% increased risk.¹⁸⁵ Forthcoming data from additional clinical trials evaluating the effect of vitamin D supplementation on cancer prevention may help clarify this association,^{186, 187} although study design modifications may be necessary to reconcile the current controversy.¹⁸⁸

Smoking

In November 2009, the International Agency for Research on Cancer reported that there is sufficient evidence to conclude that tobacco smoking causes CRC.¹⁸⁹ In the US, approximately 12% of CRCs are attributed to cigarette current or former smoking, with CRC risk in current smokers about 50% higher than that in never smokers.^{80, 190} Most studies find differences in the association by anatomic and molecular subtypes of CRC.^{2, 191, 192} Smoking is also associated with lower CRC-specific survival, particularly for current smokers.^{193, 194}

Alcohol

An estimated 13% of CRCs in the US are attributed to alcohol consumption.⁸⁰ Although there is strong evidence that heavy consumption increases risk, the magnitude of excess risk and the association with smaller quantities is less certain. A recent meta-analysis reported that light-to-moderate alcohol consumption (up to two drinks per day) was associated with a slightly lower (8%) risk than no consumption/occasional consumption, whereas very heavy drinking (more than 3 drinks per day) was

associated with a 25% higher risk.¹⁹⁵ However, other studies find excess risk with just one drink per day, rising to 44% for the heaviest drinking.^{166, 196} The association appears stronger in men, especially for heavy consumption, perhaps because women are less likely to drink heavily and/or 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.¹⁹⁷⁻¹⁹⁹ The reduction in risk appears to be stronger among individuals younger than age 70 and without excess body weight.²⁰⁰ Aspirin users who do develop CRC appear to have less aggressive tumors and better survival compared to non-aspirin users,^{201, 202} although the survival benefit may be limited to certain tumor subtypes.^{203, 204} The American Cancer Society has not conducted a formal evidence review, but currently does not recommend the use of NSAIDs for cancer prevention in the general population because of the potential side effects, namely serious gastrointestinal bleeding. However, the US Preventive Services Task Force 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 is less convincing.²⁰⁵ 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 steroid hormones, both endogenous (naturally occurring within the body) and exogenous (e.g., hormone replacement therapy and oral contraceptives), and CRC is inconsistent.²⁰⁶ Some studies have found that higher natural levels of estrogen among postmenopausal women are associated with reduced CRC risk,²⁰⁷ while others have found no association.²⁰⁸ Reduced risk associated with hormone replacement therapy appears to be confined to use of combined estrogen and progesterone formulations.^{209, 210} Recent studies do not support an association between oral contraceptive use and CRC risk.^{2, 211, 212}

Antibiotics

Emerging evidence suggests that oral antibiotic use may be associated with increased risk of CRC.^{213, 214} Antibiotics might influence risk by disrupting the critical balance of the gut microbiome. For more information on the microbiome, see Diet on (page 16).

Other drugs

Oral bisphosphonates, which are used to treat and prevent osteoporosis, may reduce CRC risk.^{215, 216}

Colorectal Cancer Screening

The typically slow course of growth from precancerous polyp to invasive cancer to advanced-stage disease provides a unique opportunity for the prevention and early detection of CRC.⁸ Screening can prevent cancer through the detection and removal of precancerous growths and detect the disease at an early stage, when treatment is usually more successful. As a result, screening reduces CRC mortality both by decreasing incidence and increasing survival.

The 2018 American Cancer Society CRC screening guideline recommends that adults ages 45 years and older undergo regular screening with a high-sensitivity stool-based test or visual examination (described below), depending on patient preference and test availability.²¹⁷ As part of the screening process, all positive results on non-colonoscopy screening tests should be followed up with a timely colonoscopy because delays in follow-up of abnormal results increase the risk of advanced CRC and CRC death.^{218, 219} The age to initiate CRC screening was

lowered from 50 to 45 years because incidence rates are increasing in younger populations, and modeling studies demonstrated that the balance of benefit to harm was more favorable for beginning screening at age 45 than at 50.^{220, 221} Although health insurance coverage for screening those at average risk before age 50 remains variable, the American Cancer Society is working aggressively to educate insurers, lawmakers, and other stakeholders about the evidence in support of screening those ages 45-49 years and the importance of expanding coverage for this group. Screening before age 45 is recommended for those at an increased risk of CRC because of family history or certain medical conditions (see page 13), with age to initiate and rescreening intervals dependent on individual circumstances. Everyone should have a conversation with their health care provider about CRC screening that includes information about cancer family history well before age 45.²²¹ Visit cancer.org/cancer/colon-rectal-cancer/early-detection/acs-recommendations for more information, 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 high-sensitivity stool-based tests, which are collected at home (Table 4). All tests have a comparable ability to improve life expectancy when performed at the appropriate time intervals and with the recommended follow-up.²²² Patients should be given information about the benefits and limitations of each screening test, and choose one based on their health, medical history, and preferences with advice from a health care professional as needed. A growing body of evidence demonstrates that offering patients different test options substantially increases adherence to screening recommendations.²²³ As a result, and because one-third of eligible adults are not up to date with CRC screening, including half of those ages 50-54 years, the American Cancer Society and the US Preventive Services Task Force guidelines do not emphasize any one test and stress that all recommended tests can help save lives.^{217, 224}

Visual examinations

Visual tests allow doctors to see the lining of the colon and rectum through an endoscope or on radiological images.

Colonoscopy

Colonoscopy is the most commonly used CRC screening test in the US. This procedure, which is usually performed by a gastroenterologist (a doctor who specializes in the digestive system) or surgeon, allows for direct visual examination of the entire colon and rectum. It can be used as a singular screening test, or may be performed as a follow-up to abnormal results from stool and other visual tests to complete the screening process. Colonoscopy has the longest rescreening interval of all test options, 10 years for average-risk individuals with normal results.

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. Then a long, slender instrument called a colonoscope is inserted into the anus and moved slowly through the rectum to the cecum (beginning of the colon). The colonoscope has a light and small video camera on the end to allow 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).²²⁵

While data are not yet available from randomized controlled trials evaluating the effectiveness of colonoscopy,²²⁶ results from several trials of flexible sigmoidoscopy, a similar test discussed in the next section, provide indirect support for the benefits of colonoscopy. In addition, observational studies suggest that colonoscopy can help reduce CRC incidence by about 40% and mortality by about 60%.²²⁷⁻²²⁹

Like all screening tests, colonoscopy has limitations and potential harms. For example, it can lead to unnecessary procedures, such as the removal of small polyps that would not have progressed to cancer.²³⁰ A recent study found that although >90% of polyps can be safely

Table 4. Characteristics of Recommended Colorectal Cancer Screening Tests

	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
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 immunochemical 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 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 - Pre-test dietary limitations - Slightly more effective when combined with a flexible sigmoidoscopy every five years - Colonoscopy necessary if positive	Annual
Multitargeted stool DNA test (Cologuard®)	- No bowel cleansing or sedation - 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. †For average-risk individuals, e.g., does not apply to those who have a history of adenoma.

removed during colonoscopy, elective surgery to remove nonmalignant polyps, which has a higher risk of harms, increased by more than 50% from 2000 to 2014.²³¹ Other 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 or patients are older.^{230, 231} Although these side effects are rare, serious bleeding occurs in 1 to 2 of every

1,000 colonoscopies.^{225, 232, 233} In addition, colonoscopy sometimes misses adenomas, especially those that are located in the proximal colon; those that occur in high-risk patients; and those that are flat (sessile adenomas), from which 20% to 30% of CRCs are thought to originate.^{226, 234} The quality of colonoscopy, which is variable in the US, is also associated with missed lesions, which sometimes progress to CRC before the next scheduled exam (i.e.,

interval cancer).^{235, 236} Low-quality colonoscopy (measured as low adenoma detection rate) is associated with a higher likelihood of interval CRC and CRC death.²³⁶

Flexible sigmoidoscopy

Sigmoidoscopy was a common screening test before 2000, but current availability is limited because it has mostly been replaced by colonoscopy (see page 23 for current prevalence of sigmoidoscopy and other screening tests). These tests are very similar except colonoscopy can examine the entire colon whereas sigmoidoscopy can only visualize the rectum and distal one-third of the colon, and must be repeated more often (Table 4). Simple bowel cleansing, usually with enemas, is sufficient 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 should be referred for a colonoscopy so that the entire colon can be examined.

Recent analysis of data from randomized controlled trials with up to 17 years of follow-up shows that sigmoidoscopy is associated with about a 20%-25% reduction in CRC incidence and a 25%-30% reduction in CRC mortality, with greater reductions in men than women.²³⁷⁻²³⁹

Computed tomographic colonography (CTC)

Also referred to as virtual colonoscopy, CTC is an imaging procedure that provides 2- or 3-dimensional views of the entire colon and rectum with the use of a special x-ray machine linked to a computer.²³⁰ 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 inflate the colon; then the patient passes through the CT scanner, which creates multiple images of the interior of the colon. CTC is less invasive than colonoscopy or sigmoidoscopy and typically takes approximately 10 to 15 minutes to complete.²⁴⁰ Patients with adenomas 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 advanced adenomas, but has lower sensitivity for smaller adenomas.²⁴¹ Potential harms include cumulative radiation exposure from regular examinations, and unnecessary tests and/or treatment due to incidental benign findings outside the colorectum. There is less evidence on the benefits and harms of this test compared to others because it is relatively new and remains uncommon.²⁴⁴ This may be because it is not covered by Medicare and commercial insurance coverage is variable; in 2019, 37 states mandated that commercial plans cover this test.²⁴²

Stool tests

Most cancerous tumors and some large adenomas 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 and timely follow-up of abnormal results will result in a reduction in mortality similar to that achieved by colonoscopy over a lifetime of screening.²⁴³ Except for the multitargeted stool DNA test, which is recommended every 3 years, stool tests should be repeated annually. However, adherence to yearly testing and timely follow-up with a colonoscopy after a positive test remains a challenge, especially in low-resource settings where stool tests are more common.²⁴⁴⁻²⁴⁷

Guaiac-based fecal occult blood test (gFOBT)

These tests use a chemical reaction to detect blood in the stool. Bleeding from cancers or adenomas may be sporadic or undetectable, so accurate results require annual testing of samples from 3 consecutive bowel movements. Patients are typically instructed to avoid nonsteroidal anti-inflammatory drugs and red meat for 3 days prior to the test because they can lead to a positive test result when no cancer is present (false positive); 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 a negative test result when cancer is present (false negative). Only high-sensitivity gFOBT are recommended for CRC screening.

Data from a large clinical trial indicated that the regular use of FOBT reduced the risk of CRC death by 32% after 30 years of follow-up.²⁴⁸ FOBT has also been shown to decrease CRC incidence by 20% by detecting large precancerous adenomas.²⁴⁹

Fecal immunochemical test (FIT)

The FIT (also sometimes referred to as the immunochemical FOBT, or iFOBT) uses antibodies against hemoglobin to specifically detect human blood in the stool and is about twice as likely as most gFOBT products to detect both advanced adenomas and cancer.^{250, 251} Many individuals prefer FIT over gFOBT because of its convenience, lack of dietary restrictions, and collection of fewer stool samples.²⁵²

Multitargeted stool DNA (Cologuard®)

This test is referred to as “multitargeted” because it not only detects blood in the stool, but also multiple genetic mutations in the DNA of cells that are shed into the stool by large adenomas and CRC. 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.²⁵³ However, because it is a relatively new test, data are still accumulating on performance characteristics in community settings. Although it is recognized as an acceptable screening option by the American Cancer Society and the US Preventive Services Task Force²²⁴ and is covered by Medicare, some private insurance companies may not cover this test. Patient navigation services, which include phone calls and reminder letters in multiple languages to support test completion, are embedded in the cost of the test, although the services do not extend to colonoscopy follow-up of abnormal results.²⁵⁴

Non-recommended tests for colorectal cancer screening

There are several tests for CRC screening that are not recommended by the American Cancer Society or other organizations because of poorer performance. These include in-office stool tests, in which a single-stool sample is collected during a digital rectal exam and placed on an FOBT card, and “toilet bowl tests,” which are over-the-counter guaiac-based tests that are often

promoted as a type of FOBT. Despite recommendations against in-office FOBT, some primary care physicians continue to offer the test.²⁵⁵ Toilet bowl tests have not been evaluated in the types of rigorous clinical studies done on the guaiac-based FOBT and FIT.

Double-contrast barium enema, also called barium enema with air contrast, is a test that takes an x-ray of the colon after barium sulfate is introduced. This test is no longer recommended because it has lower sensitivity for detecting CRC than other tests.

There are also emerging technologies that are not currently recommended for CRC screening because there was insufficient data on their performance compared to other recommended options at the time the guidelines were issued. These include blood-based tests that measure circulating genetic abnormalities associated with colorectal adenomas and cancer, and capsule endoscopy, in which the patient undergoes bowel cleansing and swallows a pill-sized device containing tiny encapsulated cameras that transmit images of the colon and rectum to a recording device.

Use of colorectal cancer screening

According to the National Health Interview Survey (NHIS), CRC screening in accordance with guidelines increased rapidly among adults ages 50 and older from 2000 (38%) to 2010 (59%), but more slowly in the past decade, reaching 66% in 2018 (Table 5).⁴⁴ The most recent NHIS data collected in 2018 contain a mix of respondents surveyed before and after the release of the American Cancer Society CRC screening guideline in mid-2018. Approximately 56% of those ≥45 years of age and 21% of those ages 45-49 years reported being up to date with CRC screening in 2018.

Among adults ages 50 and older in 2018:

- 61% reported having a colonoscopy in the past 10 years, and 3% and 1% reported having a sigmoidoscopy or CT colonography, respectively, in the past 5 years.
- Approximately 11% reported a recent stool test; 9% reported an FIT or FOBT in the past year and 3% reported stool DNA testing in the past 3 years.⁴⁴

Table 5. Colorectal Cancer Screening (%), Adults 45 Years and Older, US, 2018

	Stool test*	Colonoscopy†	Up to date‡	
	≥50 years	≥50 years	≥50 years	50-75 years
Overall	11	61	66	67
Gender				
Males	12	62	67	67
Females	10	60	64	66
Age (years)				
50-64	10	56	61	62
50-54	9	42	48	–
55-64	10	63	68	–
65+	12	66	71	77
75+	10	60	63	–
Race/ethnicity				
White	10	63	68	69
Black	12	60	65	66
Hispanic	15	52	59	59
American Indian/Alaska Native	12	53	59	56
Asian	15	47	55	58
Sexual orientation				
Gay/Lesbian	18	68	76	76
Straight	11	61	66	67
Bisexual	25	49	58	§
Education				
Less than high school	11	46	52	53
High school diploma	10	57	62	63
Some college	11	62	68	68
College graduate	11	68	73	73
Immigration status				
Born in US	10	63	68	69
Born in US territory	§	76	80	84
In US fewer than 10 years	§	20	26	30
In US 10+ years	14	49	56	58
Income level				
<100% FPL	12	49	55	57
100 to <200% FPL	12	48	55	57
≥200% FPL	11	65	70	70
Insurance status				
Uninsured	5	26	30	30
Private	9	60	65	65
Medicare or Medicare & Medicaid	14	61	67	73
Private & Medicare	11	71	74	80
Medicaid or Other state plan	14	44	53	54

FPL: federal poverty level. *Fecal occult blood test (FOBT) OR fecal immunochemical test (FIT) in the past 1 year OR stool DNA (sDNA) test in the past 3 years. †In the past 10 years. ‡For ages ≥45 and ≥50 years: FOBT/FIT, sigmoidoscopy, colonoscopy, computed tomographic colonography (CTC), or sDNA test in the past 1, 5, 10, 5 and 3 years, respectively. For ages 50-75 years: FOBT/FIT, sigmoidoscopy, colonoscopy, CTC, or sDNA test in the past 1, 5, 10, 5 and 3 years, respectively, OR sigmoidoscopy in past 10 years with FOBT/FIT in past 1 year. §Estimate not shown due to instability. Note: Estimates do not distinguish between examinations for screening and diagnosis. All estimates except for age and insurance status are age adjusted to the 2000 US standard population.

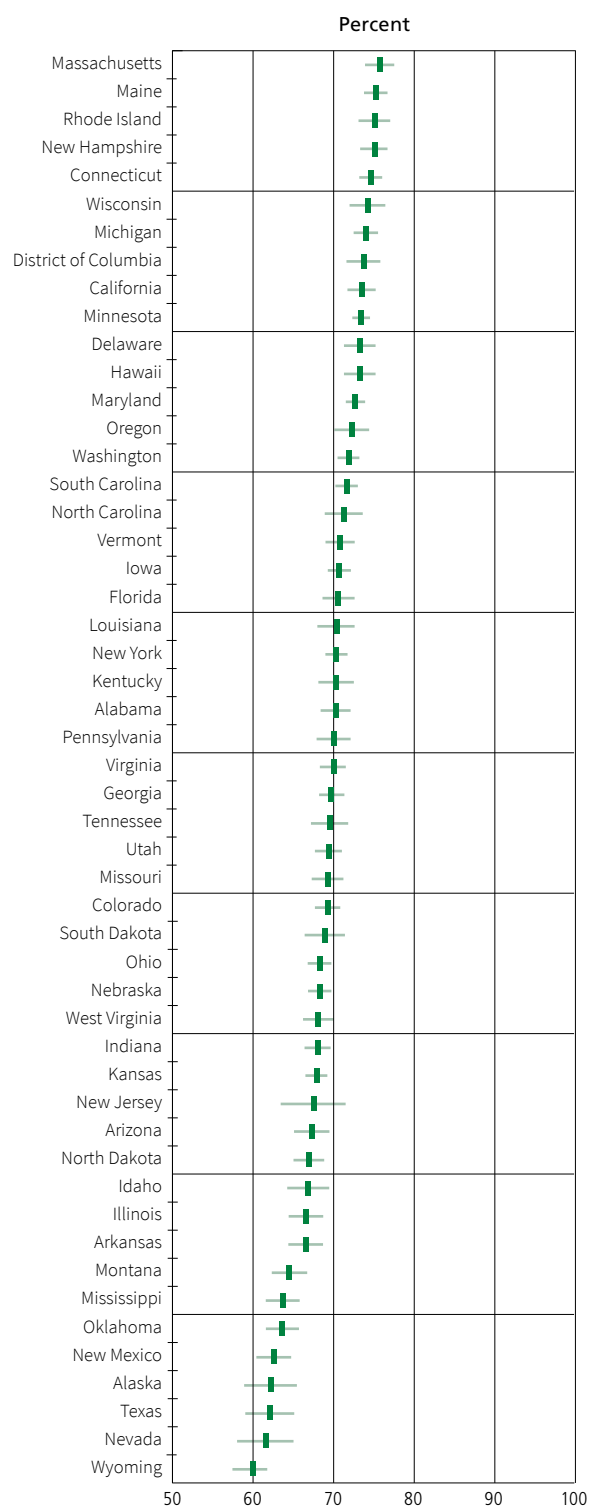
Source: National Health Interview Survey, 2018.

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- Screening was lowest among ages 50-54 years (48%); Asian Americans (55%); individuals with less than a high school education (52%); the uninsured (30%); and recent (<10 years) immigrants (26%).

The prevalence of CRC screening also varies substantially among US states and territories (see cover). According to data from the 2018 Behavioral Risk Factor Surveillance System (BRFSS):²⁵⁶

Figure 12. Colorectal Cancer Screening* (%), Adults 50 Years and Older by State, 2018



*Blood stool test, sigmoidoscopy, or colonoscopy in the past 1, 5, and 10 years, respectively. Note: Estimates are age adjusted to the 2000 US standard population and do not distinguish between examinations for screening and diagnosis.

Source: Behavioral Risk Factors Surveillance System, 2018. See Sources of Statistics (p. 32) for complete citation and more information.

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- Screening utilization ranged from 58% in Puerto Rico and 60% in Wyoming to 76% in Massachusetts (Figure 12 and Table 6).
- In all states, screening prevalence is substantially lower in people ages 50-64 years than in those age 65 and older, with the largest absolute difference in Puerto Rico (22%) and Florida, Mississippi, and Oklahoma (all 19%).

Strategies to overcome screening barriers

Screening utilization for CRC remains lower than that for breast and cervical cancers despite the large body of evidence supporting its effectiveness for reducing cancer incidence and mortality.²⁵⁷ Use of CRC screening is influenced by numerous individual, provider, health system, and community factors, as well as public policy. Barriers to screening 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.²⁵⁸⁻²⁶³ These barriers are more prevalent among people with fewer financial resources, lower educational attainment, and among racial/ethnic minorities, resulting in disparities in screening prevalence and outcomes.²⁶⁴

Interventions to help overcome these barriers include increasing individual patient awareness (e.g., education and reminders), ease of access (e.g., providing transportation, reducing out-of-pocket expenses, mailed FIT kits, patient navigators), provider delivery (e.g., provider reminders, assessment, and feedback), and community demand (e.g., media campaigns).²⁶⁵ Multi-component interventions are recommended because they are more effective at increasing CRC screening utilization than a single approach.^{265, 266} Additionally, adherence to CRC screening guidelines increases when patients are offered a variety of tests.^{222, 223, 267, 268} Importantly, however, the effectiveness of screening is compromised without timely follow-up of abnormal results. Follow-up of colonoscopy among adults with a positive stool test may be increased through the use of patient navigators and provider-level interventions, such as physician reminders and performance data, although evidence for effective strategies remains sparse.²⁶⁹

Table 6. Colorectal Cancer Screening* (%), Adults 50 Years and Older by State, 2018

	All races				Non-Hispanic white	Non-Hispanic black
	≥50 years	50 to 64 years	≥65 years	50 to 75 years	≥50 years	≥50 years
United States (median)	70	63	75	69	71	71
<i>Range</i>	<i>60-76</i>	<i>50-72</i>	<i>66-82</i>	<i>58-77</i>	<i>61-80</i>	<i>63-84</i>
Alabama	70	63	76	70	71	67
Alaska	62	52	70	60	62	†
Arizona	67	59	76	66	69	75
Arkansas	67	58	74	66	67	69
California	73	64	82	72	80	77
Colorado	69	62	74	69	71	76
Connecticut	75	71	78	75	76	76
Delaware	73	67	78	72	75	71
District of Columbia	74	69	78	74	77	73
Florida	71	61	80	69	74	67
Georgia	70	61	78	68	71	71
Hawaii	73	69	75	75	78	†
Idaho	67	59	72	66	68	†
Illinois	67	61	70	67	67	74
Indiana	68	61	73	68	69	67
Iowa	71	66	74	71	71	84
Kansas	68	60	74	67	69	66
Kentucky	70	63	76	69	70	70
Louisiana	70	64	76	69	71	70
Maine	75	69	79	75	76	†
Maryland	73	67	78	73	73	77
Massachusetts	76	72	78	77	77	82
Michigan	74	69	77	74	75	71
Minnesota	73	68	77	73	75	66
Mississippi	64	54	73	62	64	65
Missouri	69	62	75	69	69	71
Montana	65	56	71	64	65	†
Nebraska	68	62	72	68	70	67
Nevada	62	52	69	60	67	67
New Hampshire	75	70	78	75	75	†
New Jersey	68	59	75	67	69	76
New Mexico	63	55	66	64	66	†
New York	70	65	75	70	72	70
North Carolina	71	64	77	71	73	69
North Dakota	67	61	72	67	68	†
Ohio	68	61	75	67	69	68
Oklahoma	64	54	73	62	65	68
Oregon	72	66	77	72	72	†
Pennsylvania	70	66	72	72	71	68
Rhode Island	75	70	79	76	77	75
South Carolina	72	62	80	70	72	71
South Dakota	69	63	74	69	70	†
Tennessee	70	60	77	69	71	63
Texas	62	53	71	60	68	68
Utah	69	63	73	70	72	†
Vermont	71	65	72	71	71	†
Virginia	70	63	75	70	70	72
Washington	72	65	77	72	73	71
West Virginia	68	61	74	67	69	66
Wisconsin	74	69	77	75	75	82
Wyoming	60	50	67	58	61	†
Puerto Rico	58	48	70	55	†	†

*Blood stool test, sigmoidoscopy, or colonoscopy in the past 1, 5, and 10 years, respectively. †Estimate not presented due to instability. Note: Estimates are age adjusted to the 2000 US standard population and do not distinguish between examinations for screening and diagnosis. Puerto Rico not included in ranges or medians.

Source: Behavioral Risk Factor Surveillance System, 2018.

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The National Colorectal Cancer Roundtable (NCCRT), a coalition of public, private, and voluntary organizations and individuals established in 1997 by the American Cancer Society and the CDC to promote CRC screening, has produced evidence-based toolkits for policy makers, communities, health systems, and health care providers to help improve CRC screening uptake.^{270, 271} Other efforts include the CDC's Colorectal Cancer Control Program (CRCCP), which uses multicomponent interventions to increase CRC screening among low-income, underinsured, or uninsured individuals and certain racial and ethnic groups, in particular. During its first year (2015-2016), CRC screening prevalence increased by 4.4% in clinics receiving CRCCP funds, resulting in an additional 24,100 people screened.²⁷² Integrated health systems have improved CRC screening participation and reduced CRC incidence and mortality by implementing patient reminders and mailed FIT kits.²⁷³ Mailed outreach FIT programs may also be effective in community health center settings, which historically have low CRC screening rates and limited resources.²⁷⁴

On a broader scale, provisions of the Patient Protection and Affordable Care Act (ACA) removed some barriers to screening. For example, CRC screening increased faster in states that adopted the ACA provision to expand Medicaid eligibility compared to those that did not.²⁷⁵ The ACA also reduced or eliminated out-of-pocket screening costs for those who are insured, although loopholes remain.²⁷⁶ All recommended screening options, including colonoscopy, are covered without cost sharing for people with Medicare insurance and most commercial insurance plans. However, the required follow-up colonoscopy for a positive stool test 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, undermining efforts to improve CRC screening, particularly among low-income patients who are at highest risk for CRC.²⁷⁷

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, particularly for advanced disease.^{76, 278} However, it has also become increasingly clear that outcomes vary widely based on tumor-specific molecular features, tumor location, and patient characteristics.²⁷⁹⁻²⁸¹ Treatment decisions are made by patients with their physicians after considering the best options available for their tumor characteristics along with 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 (given after surgery) may also be used. Radiation is used less often to treat colon cancer.

Carcinoma in situ

Carcinoma in situ is malignant 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 polyp removal through a colonoscope (polypectomy) or more invasive surgery. 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 into (but not completely through) the wall of the colon. Surgical resection to remove the cancer, together with a length of normal colon on either side of the tumor and nearby lymph nodes, is the standard treatment.

Regional stage

Regional stage describes cancers that have grown through the wall of the colon and/or spread to nearby lymph nodes. If the cancer has not spread to nearby lymph nodes, surgical resection to remove the tumor and nearby colon and 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 is 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.²⁸² Oxaliplatin is often part of adjuvant chemotherapy as well.²⁸³

However, some patients may not tolerate this regimen given its toxicity, and there is growing appreciation for the need to confine its use to patients who are most likely to benefit.^{76, 284, 285} 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 in younger patients, although certain drugs (e.g., oxaliplatin) may be avoided to limit toxicity. However, studies indicate that individuals 75 years of age and older are far less likely than younger patients to receive this treatment.^{76, 286}

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 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. Genetic testing of tumors is important because those with certain mutations (e.g., KRAS, NRAS, or BRAF) largely do not respond to these drugs.²⁸⁷ Immunotherapy drugs are also now approved to treat a small portion of CRCs.

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 largely the same as those used for colon cancer.

Carcinoma in situ

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 tumors, 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 needed (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 (chemoradiation) before surgery. Some patients also receive chemotherapy after surgery, although the potential benefits are debated.²⁸⁸⁻²⁹⁰

Distant stage

At 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, palliative treatments (surgery, chemotherapy, and/or radiation therapy) are used to relieve, delay, or prevent symptoms and prolong life. Similar to colon cancer, a number of targeted therapies have been approved to treat select metastatic rectal cancers, including VEGF and EGFR inhibitors.

Colostomy

When a section of the colon or rectum is removed during surgery, the healthy parts can usually be reconnected, allowing the patient to eliminate waste normally. When reconnection is not immediately possible, the surgeon connects the colon to an opening (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, held in place by a special adhesive, fits over the stoma 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). Side effects should be discussed with a clinician because treatment options are often available. For example, antiemetic drugs can prevent or lessen nausea and vomiting following chemotherapy. 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 (see sidebar).²⁹¹ Short- and long-term effects of specific modes of CRC treatment are briefly described in the following sections. For more information on late and long-term effects of cancer and its treatment, visit cancer.org/treatment/treatments-and-side-effects.html.

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 surgical manipulation, which may require an extended hospital stay.²⁹² Patients are monitored for signs of bleeding, infection, or other problems that require immediate treatment.

Other 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; and urogenital/sexual dysfunction (e.g., erectile dysfunction in men).

American Cancer Society Colorectal Cancer Posttreatment Survivorship Care Guidelines

CRC 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.

Radiation therapy

Side effects of radiation therapy can include skin irritation, nausea, diarrhea, rectal irritation and/or painful inflammation, rectal bleeding, bladder dysfunction (irritation, pain, and/or frequent urination), fatigue, or sexual problems. 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 in women may damage the ovaries, causing infertility. Fertility counseling prior to treatment is recommended for women for whom this is a concern (see Sexual function and fertility, below). 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, the length of treatment, and individual patient characteristics. Some side effects are temporary (e.g., hair loss), while others may persist after

treatment (e.g., numbness in the hands or feet). Some patients may experience low blood cell counts because chemotherapy can harm 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 or shortness of breath.

Targeted therapy

Targeted therapy is a newer class of drugs resulting from an increased understanding of the molecular features of cancer development. Targeted drugs for CRC (e.g., EGFR and VEGF inhibitors) often have different but notable side effects compared to conventional chemotherapy drugs, such as dry skin or skin rash.

Sexual function and fertility

Many treatments for CRC directly or indirectly impact sexual function and fertility in both male and female patients.^{293, 294} This is a particularly relevant issue for the increasing number of affected young adults in their reproductive years. The American Society for Clinical Oncology clinical practice guidelines recommend that fertility preservation be discussed with all new patients at the time of diagnosis because efforts such as sperm banking, embryo/oocyte cryopreservation (the freezing of fertilized or unfertilized eggs), and ovarian transposition (a surgical repositioning of the ovaries away from the field of radiation) should be started far in advance of treatment.²⁹⁵ For more information, visit cancer.org/treatment/treatments-and-side-effects/physical-side-effects/fertility-and-sexual-side-effects.html.

What Is the American Cancer Society Doing about Colorectal Cancer?

Research

Colorectal cancer is an active area of scientific research; studies span the cancer continuum from prevention and early detection to treatment and beyond. As of August 1, 2019, the American Cancer Society was funding 78 grants totaling more than \$25 million in colorectal cancer research. Examples of projects in which researchers in the American Cancer Society Extramural Research program are engaged include:

- Evaluating why certain colorectal cancers evade or resist treatment
- Exploring new ways to prevent colorectal cancer by manipulating gut microbiota
- Investigating whether increased consumption of cooked dry beans, which have anti-inflammatory and anti-cancer properties, could lower the risk of colorectal cancer recurrence in survivors with obesity
- Understanding barriers to colonoscopy screening in North and South Carolina

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

Colorectal cancer screening guidelines

Since 1980, the American Cancer Society has issued evidence-based recommendations for CRC screening in average-risk adults that are generally updated every 5 years. These recommendations are developed by an independent Guideline Development Group of experts in cancer epidemiology, primary care, and health services research with the support of American Cancer Society staff in the Center for Cancer Screening, the Intramural Research program, and an ad hoc group of clinicians with expertise in CRC. As part of the ongoing guideline development process, American Cancer Society staff monitor the medical and scientific literature for new evidence that may support a change in the current recommendations, as well as new information about CRC screening that should be conveyed to clinicians and target populations. The most recent update of the American Cancer Society guideline for CRC screening was published in 2018.²¹⁷

Strategies to reach the 80% in Every Community nationwide goal

In 2014, the NCCRT launched the 80% by 2018 campaign to raise CRC screening rates across the nation. Although the nation as a whole did not achieve the 80% goal, it was reached and even surpassed in some hospital and community clinic settings, as well as in some health plans. 80% in Every Community is the new NCCRT campaign to continue efforts to substantially reduce CRC as a major public health problem by increasing colorectal screening rates to 80% or higher in communities across the nation. The NCCRT, established in 1997 by the American Cancer Society and the Centers for Disease Control and

Prevention, 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. Over the past five years, more than 1,750 organizations have committed to the shared goal of raising CRC screening utilization. This initiative emphasizes evidence-based screening activities that respond to individualized needs, barriers, and motivations within a community. Talking points, FAQs, press materials, downloadable graphics, and more are available at nccrt.org/80-in-every-community. The American Cancer Society is committed to the 80% in Every Community 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 approximately 300-strong 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 work 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, and using the power of the provider recommendation. The American Cancer Society Community Health Advocates implementing Nationwide Grants for Empowerment and Equity (CHANGE) program provides one avenue for health systems staff to collaborate at the community level. CHANGE provides both financial and technical assistance to federally qualified health centers (FQHCs) and other community partners to build capacity and implement interventions to increase cancer screening rates among low income, low education, and racially diverse populations. Since 2011, the American Cancer Society has awarded 252 grants to community-based partners to implement evidence-based CRC interventions, reaching over one million men and women with cancer prevention and

early detection education and outreach and providing more than 332,000 CRC screening exams. CHANGE grant-funded FQHCs have been found to increase screening rates faster than nonfunded FQHCs.

Additionally, the American Cancer Society works to unify and magnify effective communication to the public about the value of CRC screening through multiple channels. These activities include the development and implementation of targeted traditional and social media strategies to motivate unscreened consumers to get screened. Finally, we lead by example, encouraging our own staff and volunteers to be up to date with recommended cancer screening tests. Through these actions, the American Cancer Society is 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 NetworkSM (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 1,750 other organizations, ACS CAN hopes to reach the goal of achieving 80% or higher CRC screening rates in every community. 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 30 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 2019, 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.
- Advocating for state legislation to ensure insurance coverage in each state aligns with the American Cancer Society's evidence-based CRC guideline, which recommends average-risk adults begin screening at age 45
- Engaging governors, mayors, and state legislators to inform them about the 80% in Every Community 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 2020 was projected using a spatiotemporal model based on incidence data from 50 states and the District of Columbia for the years 2002 to 2016 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.²⁹⁶

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 Purchased/Referred Care Delivery Area (PRCDA) county regions excluding the ANTR. Incidence rates were age adjusted to the 2000 US standard population and adjusted for delays in reporting when possible. Trends exclude appendix.

Estimated cancer deaths. The estimated number of CRC deaths in the US in 2020 was calculated by fitting the actual number of CRC deaths from 2003 through 2017 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.²⁹⁷

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 are based on deaths occurring in the Alaska Community Health Service Delivery Area region. Due to data limitations, there may be a small degree of 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 national prevalence of CRC screening was estimated from the National Health Interview Survey (NHIS) 2018 data file, obtained from NCHS, released in 2019 (cdc.gov/nchs/nhis.htm). The NHIS is conducted by the US Census Bureau and is designed to provide national prevalence estimates on health characteristics such as cancer screening behaviors. Data are collected through in-person interviews.

CRC screening prevalence by state was estimated from the 2018 Behavioral Risk Factor Surveillance System (BRFSS) public use data files, obtained from the National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention. The BRFSS is a telephone survey designed to provide state prevalence estimates of health behaviors and was conducted by state health departments.

Important note about estimated cases and deaths. The projected number 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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