Cancer Screening in the United States, 2019: A Review of Current American Cancer Society Guidelines and Current Issues in Cancer Screening

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Abstract: Each year, the American Cancer Society publishes a summary of its guidelines for early cancer detection, data and trends in cancer screening rates, and select issues related to cancer screening. In this issue of the journal, the current American Cancer Society cancer screening guidelines are summarized, and the most current data from the National Health Interview Survey are provided on the utilization of cancer screening for men and women and on the adherence of men and women to multiple recommended screening tests. CA Cancer J Clin 2019;69:184-210. © 2019 American Cancer Society.

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Introduction
The American Cancer Society (ACS) provides an annual report for health care professionals and the public that summarizes the current ACS cancer screening guidelines, including current recommendations and updates, and guidance related to early cancer detection when a direct recommendation for screening cannot be made. This annual report also includes the most recent data on cancer screening rates and rates of adherence to multiple screening guidelines based on age, sex, and socioeconomic status along with a discussion of issues related to early cancer detection.

As part of the ongoing guideline development process, the ACS monitors the medical and scientific literature for new evidence that may support a change in current guidelines or the development of a new guideline, and new information about screening that should be conveyed to clinicians and target populations.1,2 These annual guideline reviews, as well as the more detailed individual cancer screening guideline updates, are published as stand-alone articles and are available online. Table 1 provides a recent history of ACS guideline updates as well as those in progress.2–22

In this update of ACS cancer screening guidelines, we describe the current guidelines (Table 2); recommendations from other organizations; the current issues shaping screening for breast, cervical, colorectal, lung, and prostate cancer; and we present the most recent data on cancer screening from the National Health Interview Survey (NHIS).

Screening for Breast Cancer
Among women in the United States, breast cancer is the most common cancer, the second most common cause of death from cancer, and a leading cause of premature mortality as measured by the average and total years of life lost.23 In 2019, the ACS estimates that there will be 268,600 cases of invasive breast
After a period of declining age-adjusted breast cancer incidence rates (1999-2004), there has been an average, delay-adjusted annual percentage increase of 0.4% from 2004 to 2015 in age-adjusted breast cancer incidence rates.\(^\text{23}\) Age-adjusted breast cancer mortality rates have declined 40% from 1989 through 2016,\(^\text{23}\) with an estimated 348,800 expected deaths averted in US women over this period if the age-adjusted mortality rate had not declined since 1989.\(^\text{25}\) Unfortunately, these overall favorable mortality statistics are not shared equally among all populations. Although declines in death rates are observed in all racial/ethnic groups, a large disparity in age-adjusted death rates emerged between black women and white women during the 1980s and continued to increase for several decades. Although these differences have stabilized in recent years, over the period from 2011 to 2016, death rates were 41% higher in black women compared with white women.\(^\text{23}\)

In 2015, the ACS issued a strong recommendation that average-risk women aged 45 years and older should undergo regular mammography screening and a qualified recommendation that women aged 40 to 44 years should have an opportunity to begin screening before age 45 years (Table 2).
| CANCER SITE | POPULATION | TEST OR PROCEDURE | RECOMMENDATION |
|-------------|------------|-------------------|----------------|
| Breast      | Women aged 40-54 y | Mammography | Women should undergo regular screening mammography starting at age 45 y; women aged 45-54 y should be screened annually; women should have the opportunity to begin annual screening between ages 40 and 44 y |
|             | Women aged ≥55 y | Mammography | Women aged ≥55 y should transition to biennial screening or have the opportunity to continue screening annually; women should continue screening mammography as long as their overall health is good and they have a life expectancy of 10 y or longer |
| Cervix      | Women aged 21-29 y | Pap test | Cervical cancer screening should begin at age 21 y; for women aged 21-29 y, screening should be done every 3 y with conventional or liquid-based Pap tests |
|             | Women aged 30-65 y | Pap test and HPV DNA test | For women ages 30-65 y, screening should be done every 5 y with both the HPV test and the Pap test (preferred) or every 3 y with the Pap test alone (acceptable) |
|             | Women aged >65 y | Pap test and HPV DNA test | Women aged >65 y who have had ≥3 consecutive negative Pap tests or ≥2 consecutive negative HPV and Pap tests within the last 10 y, with the most recent test occurring in the last 5 y, should stop cervical cancer screening |
|             | Women who have had a total hysterectomy | | Women who have had a total hysterectomy should stop cervical cancer screening |
| Colorectal  | Men and women, aged 45-75 y, for all tests listed | Fecal immunochemical test (annual), or high-sensitivity guaiac-based fecal occult blood test (annual), or multi-target stool DNA test (every 3 y, per manufacturer's recommendation), or colonoscopy (every 10 y), or CT colonography (every 5 y), or flexible sigmoidoscopy (every 5 y) | Adults aged 45 y and older should undergo regular screening with either a high-sensitivity, stool-based test or a structural (visual) examination, depending on patient preference and test availability; as part of the screening process, all positive results on noncolonoscopy screening tests should be followed with timely colonoscopy; adults in good health with a life expectancy of greater than 10 y should continue screening through the age of 75 y |
|             | Men and women aged 76 through 85 y | | Screening decisions should be individualized based on patient preferences, life expectancy, health status, and prior screening history; if a decision is made to continue screening, the patient should be offered options as listed above |
|             | Men and women aged >85 y | | Individuals should be discouraged from continuing screening |
| Endometrial | Women, at menopause | | At the time of menopause, women should be informed about risks and symptoms of endometrial cancer and strongly encouraged to report any unexpected bleeding or spotting to their physicians |
| Lung        | Current or former smokers aged 55-74 y in good health with at least a 30-pack-y history of smoking | Low-dose helical CT | Annual screening in adults who: |
|             | | | • Currently smoke or have quit within the past 15 y; and |
|             | | | • Have at least a 30-pack-y smoking history; and |
|             | | | • Have undergone a process of informed/shared decision making that included information about the potential benefits, limitations, and harms of screening with low-dose CT; and |
|             | | | • Have access to a high-volume, high-quality lung cancer screening and treatment center |
| Prostate    | Men aged ≥50 y | Prostate-specific antigen test with or without digital rectal examination | Men who have at least a 10-y life expectancy should have an opportunity to make an informed decision with their health care provider about whether to be screened for prostate cancer after receiving information about the potential benefits, risks, and uncertainties associated with prostate cancer screening; prostate cancer screening should not occur without an informed decision-making process |

Abbreviations: CT, computed tomography; HPV, human papillomavirus; Pap test, Papanicolaou test.

*All individuals should become familiar with the potential benefits, limitations, and harms associated with cancer screening.*
A “strong” recommendation is an indication of consensus that the benefits of the intervention outweigh undesirable effects and an expectation that most individuals would choose to undergo the recommended intervention. In contrast, a “qualified” recommendation indicates consensus that there is evidence of benefit but less certainty either about the balance of benefits and harms or about patients’ values and preferences for the intervention. The ACS recommends that women aged 45 to 54 years and those aged 40 to 44 years who choose to begin screening before age 45 years should be screened annually and that women aged 55 years and older should transition to biennial screening or can continue annual screening if that is their preference. Women should continue screening mammography as long as their overall health is good and they have a life expectancy of 10 years or longer (qualified recommendation).5

The ACS breast cancer screening guideline emphasizes annual screening under 55 years, because biennial mammography screening in premenopausal women is associated with an increased risk of being diagnosed with advanced breast cancer, which is associated with an increased risk of breast cancer death, compared with annual screening.26 Among postmenopausal women, annual screening did not confer the same advantage of more favorable tumor characteristics that was observed in premenopausal women, except for women who were currently using menopausal hormone therapy. The ACS recommends that women aged 55 years and older can transition to biennial screening or, if it is their preference, may continue annual screening. The ACS does not set a stopping age for breast cancer screening but acknowledges the potential for women aged 75 years and older in good health with an expected longevity of 10 or more years to benefit from continuing mammography screening.

Although there has been a long-standing debate over whether mammography screening in average-risk women should begin at age 40 or 50 years, the evidence generally has been considered narrowly by focusing only on meta-analyses of randomized controlled trials (RCTs) and results from microsimulation models. In the 2015 update, the ACS examined the burden of disease over the 20-year period between ages 40 and 59 years, results from observational studies and individual RCTs in addition to meta-analyses, and new evidence on the risk of being diagnosed with a breast cancer that has advanced tumor features based on time since the last normal screening mammogram.

In framing the ACS recommendations, attention was given to indicators of the age-related burden of disease within smaller age ranges, particularly the absolute risk in 1-year and 5-year age groups, proportions of all incident breast cancer cases, proportions of annual breast cancer deaths attributable to an age at diagnosis, and potential person-years of life lost attributable to a death from breast cancer. What was clear was that traditional comparisons between women aged 40 to 49 years versus 50 years and older or between those aged 40 to 49 years versus 50 to 59 years obscured important similarities in risk among the nearly 22 million women aged 45 to 54 years.27 The risk among women aged 40 to 44 years was lower and more similar to the risk among women in their late 30s, leading the ACS not to make a direct recommendation for screening in this age group but, rather, to endorse that women in this age group have an opportunity to choose whether to begin screening before age 45 years.5

There is consistent evidence from RCTs and observational studies of modern service screening that invitation or exposure to mammography screening compared with usual care is associated with reduced breast cancer mortality overall as well as in women aged 40 to 49 years and 50 years and older.28 The magnitude of the observed mortality reductions varied across the different study designs, ranging from 15% to 54% fewer deaths associated with mammography screening, depending on the study design and whether the mortality reduction was associated with invitation versus exposure to screening. In a supplemental analysis focused on the breast cancer screening interval, Miglioretti et al observed that menopausal status rather than age was associated with screening outcomes based on time since last normal screening mammogram. Women who were premenopausal and underwent biennial mammography had higher proportions of tumors that were stage IIB or higher, with tumor size greater than 15 mm, or had any unfavorable prognostic characteristics compared with women who underwent annual mammography screening.26 In contrast, a 12-month versus 24-month screening interval was not associated with a higher rate of tumors with less favorable prognostic characteristics among postmenopausal women who were not using hormone-replacement therapy. These findings led the ACS to recommend a hybrid screening program in which women aged 45 to 54 years (and women aged 40–44 years who chose to begin screening before age 45 years) undergo annual screening, and women aged 55 years and older should transition to biennial screening, unless they choose to continue annual screening.

The process of screening necessarily involves potential harms, including false-positive findings associated with being recalled for further evaluation, a negative biopsy after referral based on abnormal mammography, and the anxiety that may be associated with each. Other harms include the possibility of overdiagnosis and overtreatment as well as radiation exposure. These differ quantitatively in terms of their observed and estimated occurrences and qualitatively in terms of the effect, importance, and degree of adverse effects experienced by different women. Because the burden of disease from age 40–44 is dissimilar to that of women aged 45–54, there was uncertainty as to whether most women would choose to begin screening at age 40 or wait until age
45, and thus a qualified recommendation for the opportunity to choose to begin screening between ages 40-44 was issued. The ACS affirms that the benefits of screening outweigh the harms within the age groups for which breast cancer screening is recommended directly or as an acceptable choice. The ACS does not set an age at which to discontinue screening. More than one-third of all breast cancer deaths each year are attributable to women who are diagnosed after age 70 years, and since a significant fraction of women are in good health past the age of 70, the guideline states that women in good health with at least 10 years of projected longevity should continue mammography screening. In applying clinical judgement about longevity, clinicians should use mortality indices that incorporate age, comorbidities, and functional status. In addition, women should be provided opportunities for individualized decision making that consider potential benefits and harms and incorporate health priorities and patient preferences.

Although strong supporting evidence for the effectiveness of mammography continues to accumulate, from both individual studies and systematic reviews of the evidence, some investigators have evaluated registry data and concluded that observed declines in the breast cancer mortality rate mostly are attributable to advances in modern therapy and not early detection. The study designs commonly used to draw this conclusion have been criticized principally for poor methodology (ie, the failure to distinguish between screened and unscreened cohorts, including censoring deaths that occur in the screening era attributable to diagnoses in the prescreening era, lack of adequate follow-up time, and failures to adjust for changes in incidence rates over time).

Two recent articles counter the argument that mammography has diminishing importance in the era of modern therapies and are instructive in how we should understand the benefits of mammography screening. Each also highlights the limitations of drawing conclusions about the benefit of screening, or the relative contributions of screening versus therapy, without data on exposure to mammography at the time of diagnosis. Beau et al examined mammography screening in the Copenhagen and Danish national registers and compared the observed breast cancer mortality rate in women who were invited to screening with the expected rate in the absence of screening. The study included data from 976,743 Copenhagen women who were invited to screening and 17,804,549 control participants (from the rest of Denmark, excluding Copenhagen, Funen, Frederiksberg, Bornholm, and Vest Sjaelland) during the same period, totaling 18,781,292 person-years of data, with an average of 11.6 years of follow-up time from the date of invitation to screening. The statistical analysis was based on 3 hypothetical models. In what the authors labeled as the “naive model,” all breast cancer deaths occurring during the follow-up period were included, without determination of exposure to mammography screening or whether the deaths were attributable to a diagnosis before the first invitation to screening. In this model, the benefit of mammography screening is diluted by deaths that occur in women not attending mammography screening and women who were diagnosed before the initiation of the mammography screening program. In the naive model, comparing the Copenhagen study group with the unexposed group, a 10% reduction in breast cancer deaths was observed. In the second model, the “follow-up model,” breast cancer deaths in the screening period attributable to cases in women who were diagnosed before the initiation of the screening period are censored, but there is no adjustment for deaths in women who were invited to screening but whose diagnosis occurred after they were no longer eligible for screening (ie, after they had aged out of the screening program). In this model, the benefit of mammography is diluted by deaths that occur in women who were diagnosed after an age when they were no longer eligible for mammography screening. In the follow-up model, breast cancer mortality was 11% lower in the Copenhagen study group compared with the unexposed group. The third model, the “evaluation model,” examines the effect of mammography screening only among the breast cancer cases diagnosed during the period when women were invited to screening. The evaluation model ensures that only women with the potential to benefit from screening are included in the analysis (ie, it excludes women who have a breast cancer diagnosis after they are no longer eligible for screening). With greater specification of exposure to screening, a 20% difference in breast cancer mortality was observed in the Copenhagen group compared with the unscreened group. Most notable in this analysis is that, compared with the naive and follow-up groups, only 43% of the observed breast cancer deaths occurred in women who were eligible for screening and thus were included in the evaluation study design, highlighting the potentially very high rates of contamination and bias in study outcomes that reflect breast cancer deaths in women who had no opportunity to benefit from mammography screening.

The second study is an analysis from the Swedish Organized Service Screening Evaluation Group, which examined the incidence of fatal breast cancers over a 58-year period using comprehensive registries for population, screening history, breast cancer incidence, and disease-specific death data from a defined population in Dalarna County, Sweden. Their analysis used a new methodology that examines the rate of breast cancers that are fatal within 10 and 20 years from the date of diagnosis in women attending and not attending mammography screening. Because the denominator for the rate of fatal breast cancer was based on the midyear population of women aged
40 to 69 years residing in Dalarna County during each of the years from 1958 to 2015, this methodology overcomes the influence of length bias when the denominator is breast cancer cases or deaths. Lead-time bias is largely overcome by the length of the follow-up period, because most women who are destined to die from breast cancer will have died within 20 years. An adjustment for selection bias also was necessary because women who did not attend screening after 1989 had made a choice not to attend screening. The question about the relative influence of modern therapies is addressed by the simple fact that all women who were diagnosed with breast cancer at age 30 years are recommended for women with a known BRCA mutation, women who are untested but have a first-degree relative with a BRCA mutation, or women with an approximately 20% to 25% or greater lifetime risk of breast cancer based on specialized breast cancer risk-estimation models capable of pedigree analysis of first-degree and second-degree relatives on both the maternal and paternal side. Annual MRI and mammography also are recommended for women who were treated for Hodgkin disease with radiation to the chest under age 30 years as well as women with Li-Fraumeni, Cowden, and Bannayan-Riley-Ruvalcaba syndromes and their first-degree relatives. At the time these recommendations were issued, there was insufficient evidence to recommend MRI and mammography for women at elevated risk because of other risk factors. Currently, the ACS is updating its guideline for women at increased and high risk.

Since publication of the 2007 ACS recommendations for women at high risk, several main points of criticism have been expressed in the academic literature and by practicing clinicians about the stated risk threshold and the suggested approach to risk assessment as a basis for decisions about different screening. A principal issue that has been raised relates to the discordance among risk estimates resulting from use of the recommended tools (BRCAPRO, Claus, BOADICEA [Breast and Ovarian Analysis of Disease Incidence and Carrier Estimation Algorithm], and Tyrer-Cuzick) because of differences in underlying assumptions about the nature of genetic risks, different upper-age limits for lifetime risk estimates, the extent of family history included in each model, and the incorporation of other risk factors. Critical attention has also focused on relying on an estimate of remaining lifetime risk, the definition of which may vary and which is difficult to evaluate empirically, rather than on 5-year or 10-year risk estimates.

For the current update, the ACS has commissioned a systematic review of the evidence to inform breast cancer screening recommendations for women at higher than average risk. The evidence review will examine risk and screening outcomes in subgroups of women, including some for whom the available evidence was judged in 2007 as not sufficient to support a recommendation for differential screening. In addition to confirmed or suspected mutation carrier status and family history, the review will examine risk and screening outcomes in women with a personal history of breast cancer (including ductal carcinoma in situ); a history of biopsy-confirmed, high-risk benign conditions (atypical ductal hyperplasia, lobular breast neoplasia [atypical lobular hyperplasia and lobular carcinoma in situ], atypical columnar cell hyperplasia, papillary lesions of the breast, or radial scar); significant mammographic breast density; recent or current use of hormone-replacement therapy; and in black women. The International Guideline Harmonization Group for Late Effects of Childhood Cancers has conducted a systematic evidence review and is currently updating its recommendations for breast cancer screening in women who received treatment with radiation to the chest at a young age.

Since 2007, ongoing research has focused on improving the accuracy of risk-assessment models, including expanding the number of risk factors that are incorporated into the models, and their use in clinical and research settings has increased. The ACS review and the guideline update...
will address thresholds of risk related to various dominant or combinations of risk factors and the appropriate use of available risk-assessment tools.

**Screening for Cervical Cancer**

The ACS estimates that 13,170 women will be diagnosed with invasive cervical cancer, and 4250 women will die from the disease in 2019. Cervical cancer incidence and mortality rates have declined since the introduction of the Papanicolaou (Pap) test in the mid-20th century, and the rates continue to decline to this day. For the period from 2006 through 2015, delay-adjusted cervical cancer incidence rates have decreased nonsignificantly at an average annual percentage rate of 0.2% per year and, between 2006 and 2015, cervical cancer mortality rates have declined at an average annual rate of 0.7%.

The 2012 joint guideline of the ACS, the American Society for Colposcopy and Cervical Pathology (ASCCP), and the American Society for Clinical Pathology (ASCP) recommends screening strategies and options based on a woman's age, screening history, and choice of screening tests.

**Women Aged 21 to 65 Years**

- Screening for cervical cancer should begin at age 21 years. Women younger than 21 years should not be screened regardless of the age of sexual initiation or other risk factors.
- For women aged 21 to 29 years, screening with cytology alone every 3 years is recommended. Human papillomavirus (HPV) testing should not be used to screen women in this age group, either as a stand-alone test or as a cotest with cytology.
- For women aged 30 to 65 years, the preferred approach is cotesting with an HPV test and cytology every 5 years. It is also acceptable for women to continue to be screened every 3 years with cytology alone.
- Women with an HPV-negative, atypical squamous cells of undetermined significance (ASC-US) result should return for screening in 3 years.
- Recommended screening practices should not change based on a woman's HPV vaccination status.

**Women Older Than 65 Years**

- Women should discontinue screening after age 65 years if they have had 3 consecutive negative cytology tests or 2 consecutive negative cotest results within the 10-year period before ceasing screening, with the most recent test occurring within the last 5 years. Women with an HPV-negative ASC-US result should be regarded as negative for the purpose of discontinuing screening. Once screening is discontinued, it should not resume for any reason, including a woman having a new sexual partner.
- After spontaneous regression or appropriate management of cervical intraepithelial neoplasia 2 (CIN2), CIN3, or adenocarcinoma in situ, routine screening should continue for at least 20 years (even if this extends screening past age 65 years).

Additional details for managing cervical cancer screening in women with abnormal findings or with different risk are detailed in the guideline. In 2019, ASCCP will host a consensus process to update the 2012 Consensus Guidelines for Managing Abnormal Cervical Cancer Screening Tests and Cancer Precursors. A description of the process and key literature that is being used to inform the guideline is available.

**Special Considerations**

These recommendations are intended for women at average risk and do not apply to women with a history of cervical cancer; women who were exposed in utero to diethylstilbestrol; women who are immunocompromised by organ transplantation, chemotherapy, or chronic corticosteroid treatment; or women who are positive for the human immunodeficiency virus (HIV). In addition, women who have had their cervix removed should not be screened unless they have a history of CIN2 or a more severe diagnosis (≥CIN2). Women who have undergone a subtotal (supracervical) hysterectomy should be screened following the recommendations for average-risk women who have not undergone a hysterectomy. Women who have a history of ≥CIN2 should continue to follow routine screening recommendations for women aged 30 to 65 years for at least 20 years, even if screening extends beyond age 65 years.

Authors of the 2012 guideline anticipated the emergence of HPV testing as a stand-alone screening test for cervical cancer and noted unresolved issues, which included the lack of management strategies for positive results, the lack of standards for HPV assays, and practical implementation challenges. In 2014, the US Food and Drug Administration (FDA) approved an HPV DNA test for primary cervical cancer screening (ie, as a stand-alone test without concomitant cytology testing), and an additional test was approved in 2018. In 2015, interim clinical guidance was developed for providers interested in primary HPV testing as a screening approach.

The US Preventive Services Task Force (USPSTF) published updated recommendations for cervical cancer screening in 2018 that are similar to those in the 2012 update but now include a recommendation for high-risk HPV (hrHPV) testing alone every 5 years as a screening option for women aged 30 to 65 years. The USPSTF recommends screening for cervical cancer every 3 years with cervical cytology alone in women aged 21 to 29 years. For women aged 30 to 65 years, the USPSTF recommends screening every 3 years with cervical cytology alone, every 5 years with hrHPV testing alone, or every 5 years with hrHPV testing in combination with cytology (cotesting). The draft recommendations...
issued for public comment in 2017 did not include cotesting as a screening option, in large part based on a judgment that both the clinical trial evidence and modeling findings suggested that cotesting substantially increases the number of follow-up tests but does not lead to increased detection of ≥CIN3 compared with hrHPV testing alone.\(^5^7\) In the final recommendations, cotesting was restored as a third option for screening women aged 30 to 65 years.\(^5^5\) In its final recommendation statement, the USPSTF acknowledged the influence of the many comments questioning the description of differences between cotesting and primary hrHPV testing and expressing concerns about the availability of FDA-approved tests for primary hrHPV cervical cancer screening.

Although there is little question that hrHPV testing alone eventually will dominate cervical cancer screening, there still is uncertainty about the best strategies for screening and management, whether a primary hrHPV screening strategy is feasible for all women in all settings, and whether women and health care professionals who are still looking back to an older paradigm of annual Pap testing are ready to accept a strategy with a newer test and an extended screening interval. The accumulation of additional studies of the newer approaches to screening may lead to greater confidence in new testing protocols. Other potential changes in screening protocols include the potential for HPV testing with self-sampling specimen collection at home as a means of increasing participation in screening.\(^5^9\) The 2018 USPSTF recommendations did not revisit the age at which to start or exit cervical cancer screening, and the current and future impact of HPV vaccination on screening outcomes was not fully addressed in the evidence review or the recommendation statement.\(^5^5,5^9\) In addition, in this new era of cervical cancer prevention, important questions remain about the appropriate intervals for screening and acceptable risk thresholds. An update of the ACS 2012 guideline is currently underway, with consideration being given to all these factors. As indicated by the USPSTF statement about their response to the public comments, there are acknowledged concerns about the speed of change in cervical cancer scientific understanding, technology, and screening recommendations and related expected challenges in national implementation.

**Vaccination Against HPV**

Persistent HPV infection accounts for virtually all of cervical cancers; 90% of anal cancers; 70% of oropharyngeal cancers; and 60% to 70% of vaginal, vulvar, and penile cancers.\(^6^0\) Although 3 HPV vaccines have been approved by the FDA, the 9-valent HPV vaccine is the only vaccine currently offered in the United States.\(^6^1\) According to a recent report from the Centers for Disease Control and Prevention (CDC), of the estimated 33,700 cancers attributable to HPV each year during 2011 through 2015, about 31,200 could have been averted by the 9-valent HPV vaccine.\(^6^2\)

HPV vaccination results in lower prevalence of HPV-related cervical abnormalities and, subsequently, the lower positive predictive value of cytology. This observation is supported in recent findings by Castle et al in their examination of the absolute and relative cumulative risks of ≥CIN2 and ≥CIN3 diagnoses in women aged 21 to 24 years undergoing cervical screening in a large, integrated health care system.\(^6^3\) Women who were vaccinated for HPV before age 18 years had less than one-half the estimated 3-year risks of ≥CIN2 and ≥CIN3 compared with unvaccinated women. The authors suggested a need to modify screening and management protocols for women who are vaccinated at a young age.\(^6^3\)

Similar findings of HPV vaccine effects were reported in a Canadian population that implemented school-based HPV vaccination in 2008. Kim et al assessed the influence of vaccination on Pap test cytology results using databases that linked vaccination and cervical cancer screening results.\(^6^4\) Kim et al reported reduced prevalence of HPV-related cervical abnormalities, particularly high-grade cervical abnormalities. Similar findings from Australia, one of the earliest countries to implement HPV vaccination, reported that detection rates of histologically confirmed, high-grade cervical abnormalities and high-grade cytology were significantly lower for vaccinated women (any dose) compared with unvaccinated women.\(^6^5\) Those reports concluded that these and other similar favorable effects of HPV vaccination on pathology outcomes will reduce the positive predictive value of screening with cytology.\(^6^6\) Also, the reduced prevalence of cervical abnormalities could result in the referral of fewer women to colposcopy, potentially disrupting the benefit-harm balance of current screening strategies.\(^6^4,6^5\)

Authors of the 2012 ACS, ASCCP, ASCP guideline concluded that all screening recommendations, including age to initiate screening, screening interval, and acceptable screening technologies, should continue to be followed by all women, regardless of vaccination status. This was based in part on very low levels of vaccination coverage in the United States (and extremely small numbers of vaccinated women who had reached screening age). In Australia, which has had an effective, publicly funded, school-based vaccination program, the impact of HPV vaccination on lower risks for both vaccinated and unvaccinated young women was one (but not the only) factor in the recent change in the starting age (to age 25 years) in updated cervical cancer screening recommendations. As levels of vaccination at the recommended age slowly increase in the United States (and additional HPV types are covered by available vaccines), all guideline developers are now anticipating the future impact of vaccination on screening outcomes and recommendations. At this time, it is important that all women, regardless of whether they have been vaccinated, get screened for cervical cancer and precancers according to current recommendations.\(^1^0\)

The ACS endorses the Advisory Committee on Immunization Practices recommendations for use of HPV
vaccination as follows: All children should be vaccinated at age 11 or 12 years to protect against HPV infections that lead to several cancers and precancers. The vaccination series can be started beginning at age 9 years. For persons initiating vaccination before the 15th birthday, the recommended immunization schedule is 2 doses of HPV vaccine. The second dose should be administered 6 to 12 months after the first dose (a 0-month and 6-month to 12-month schedule). Late vaccination for those not vaccinated at the recommended ages should be completed as soon as possible. Three doses remain recommended for those who initiate the vaccination series at age 15 through 26 years and for immunocompromised persons. Providers should inform unvaccinated men and women aged 22 to 26 years that vaccination may not be effective in lowering their cancer risk. In October 2018, the FDA approved expansion of the HPV vaccination to women aged 22 to 26 years that vaccination may not be effective in lowering their cancer risk.

Rates of HPV vaccination lag behind the rates of other vaccines administered at the same age. Roughly one-half (49%) of adolescents aged 13 to 17 years have received the recommended number of doses, and two-thirds (66%) have started the series. These rates have been increasing about 5% per year. Although the increase in encouraging, there is still much work to be done.

The ACS partners with the CDC on 2 initiatives aimed at increasing HPV vaccination rates and ultimately reducing the incidence of and mortality from HPV-associated cancers and cervical precancerous lesions. The National HPV Vaccination Roundtable is a national coalition of organizations working together to prevent HPV-associated cancers and precancers by increasing and sustaining US HPV vaccination. Additional information is available on the National HPV Vaccination Roundtable website. The HPV VACs (Vaccinate Adolescents Against Cancers) Program focuses on expanding current cancer prevention and early detection interventions in federally qualified health care centers and large health systems to increase HPV vaccination through improved provider awareness and education and improved system-wide processes. In addition, the ACS is partnering with state health departments and other state-based entities to facilitate system changes that increase the availability and utilization of the HPV vaccine.

Screening and Surveillance for the Early Detection of Adenomatous Polyps and Colorectal Cancer

In 2019, the ACS estimates that 145,600 new cases of colorectal cancer (CRC) will be diagnosed in women and men, and 51,020 women and men will die from this disease. CRC incidence and mortality rates have been declining for the past 2 decades among adults aged 50 years and older, which is largely attributable to the contribution of screening to prevention and early detection. Among individuals aged ≥50 years, CRC incidence declined by 32% between 2000 and 2013, and CRC mortality declined by 34% between 2000 and 2014, although mortality increased among those younger than 50 years, which is attributable to the rising incidence of CRC in successive age cohorts born between 1950 and 1990. CRC incidence and mortality also remain higher among blacks than among any other racial/ethnic group, with incidence rates 20% higher and mortality rates 40% greater than those among non-Hispanic whites.

The ACS updated its guideline for CRC screening in individuals at average risk in 2018. The ACS recommends that adults aged 45 years and older with an average risk of CRC undergo regular screening with either a high-sensitivity stool-based test or a structural (visual) examination, depending on patient preference and test availability. As a part of the screening process, all positive results from noncolonoscopy screening tests should be followed with timely colonoscopy. The recommendation to begin screening at age 45 years is a qualified recommendation. The recommendation for regular screening in adults aged 50 years and older is a strong recommendation.

The ACS recommends (qualified recommendation) that: 1) average-risk adults in good health with a life expectancy of greater than 10 years continue CRC screening through the age of 75 years; 2) clinicians individualize CRC screening decisions for individuals aged 76 through 85 years, based on patient preferences, life expectancy, health status, and prior screening history; and 3) clinicians discourage individuals older than 85 years from continuing CRC screening. The options for CRC screening are: fecal immunochemical test (FIT) annually, high-sensitivity guaiac-based fecal occult blood test (gFOBT) annually, multtarget stool DNA test every 3 years, colonoscopy every 10 years, computed tomography (CT) colonography every 5 years, or flexible sigmoidoscopy every 5 years.

Although there is very limited empirical evidence on screening outcomes in adults younger than 50 years (because of the traditional starting age of 50 years in research studies and clinical practice), the qualified recommendation that average-risk adults begin screening at age 45 years is based on the prolonged trends in disease burden showing increases in CRC incidence and mortality in adults younger than 55 years and modeling analyses showing efficient strategies for CRC screening starting at age 45 years. The underlying evidence pertaining to rising incidence in adults younger than 55 years was discussed in detail in the guideline article and was summarized in last year’s annual cancer screening update.
The 2018 CRC screening guideline does not prioritize among screening tests, emphasizing instead that screening utilization and adherence could be improved by offering a choice of tests at the time of referral to CRC screening. Health professionals should provide guidance to adults about the benefits, limitations, and burdens associated with screening test options to assist them in making a choice and completing screening. For example, when advising patients about gFOBT or FIT, it is important to stress that there must be a commitment to annual at-home testing with adherence to manufacturer’s instructions, or the limited sensitivity observed with one-time testing would make stool testing a poor choice. Evidence from randomized clinical trials and modeling has demonstrated that a commitment to annual testing with high-sensitivity stool tests can result in a reduced risk of developing CRC and a reduced risk of dying from CRC that rivals colonoscopy. The guideline emphasizes the importance of selecting a stool-based test that has been evaluated in a population-based study and has met performance standards to qualify as a high-sensitivity test. Single-panel gFOBT in the medical office using a stool sample collected during a digital rectal examination (DRE) is not a recommended option for CRC screening because of its very low sensitivity for advanced adenomas and cancer.

The 2018 ACS recommendation to lower the age to begin CRC screening to age 45 years was criticized in 3 commentaries by gastroenterologists shortly after publication. The common threads across these 3 critiques were: 1) concerns that the prevalence of disease in the group aged 45 to 49 years is low and that the new guideline reduces the absolute risk threshold to begin screening (specifically compared with age 50 years); 2) the absence of empirical evidence for the effectiveness of screening adults between ages 45 and 49 years; 3) the use of microsimulation modeling to compare projected outcomes and the balance of benefit to burden/harms; and 4) the possibilities that resources will be diverted to lower risk, younger populations, that colonoscopy capacity will be stressed, and that this stress will exacerbate existing disparities. With respect to the age-specific burden of disease, what is not acknowledged in any of these critiques is uncontestable evidence that the age-specific incidence of CRC in adults aged 45 years in the most recent registry data from the National Cancer Institute’s Surveillance, Epidemiology, and End Results system is at approximately the same level it was for adults aged 50 years in the 1990s, when most guidelines settled on age 50 years as the age to begin screening. Although it can be argued that there are not clear standards for determining a starting age for screening or there is no consensus about the thresholds of absolute risk for determining a starting age, in this instance, it seems that we have accepted beginning screening average-risk adults at age 50 for the past 20 years, and it is puzzling why that same level of risk (now evident at a starting age of 45 years) is being questioned. Data from the National Cancer Institute’s Surveillance, Epidemiology, and End Results program indicate that the CRC incidence rate for adults aged 45 years in 2014 and 2015 was 28.0 per 100,000 population (95% confidence interval [95% CI], 24.5%-31.8%), compared with 32.0 per 100,000 population (95% CI, 27.5%-37.1%) in adults aged 50 years in 1992 and 1993. Furthermore, with respect to the absence of sufficient empirical evidence of screening outcomes to begin screening at age 45 years, in 2009, the American Gastroenterological Society recommended screening blacks beginning at age 45 years; in 2012, the American College of Physicians recommended screening blacks beginning at age 40 years; and, in 2017, both the United States Multi-Society Task Force (USMSTF) and the American Society of Gastrointestinal Endoscopy recommended that blacks begin CRC screening at age 45 years. The basis for these recommendations was the higher burden of disease measured by earlier age at onset, higher incidence, and higher mortality. In 2017, the USMSTF screening guideline stated that “the scientific rationale for beginning screening earlier includes the higher overall incidence rates and younger mean age at onset of CRC in African Americans.” Over the years and recently, these recommendations have been put forth, justifiably in our judgment, based on the higher burden of disease; in each instance, the lack of evidence on screening outcomes in this group was noted. However, when the ACS Guideline Development Group was evaluating the evidence to determine whether a younger age to start screening should be recommended for blacks as well as American Indians and Alaska Natives, it became evident that the incidence rate of CRC for individuals younger than 50 years was no longer higher in blacks compared with whites. On the basis of this observation, the ACS evaluated simulations of CRC screening scenarios by age, sex, and ethnicity using 2 of the 3 Cancer Intervention and Surveillance Modeling Network models that also were used by the USPSTF but were modified to reflect the higher incidence observed in younger cohorts and expected to carry forward into the age groups targeted for screening. When the models were refined with the updated incidence data, 2 microsimulation models predominately indicated that screening scenarios with a starting age of 45 years had more favorable efficiency ratios than scenarios in which screening started at age 50 years. Although it is true that microsimulation modeling is not “real life,” these models have been validated against past empirical evidence and provide an opportunity to simulate screening scenarios for which there is little near-term (if ever) chance of examination in a large, prospective study. The remaining critiques may be judged as cautionary and, as one critique emphasized, may be related to the potential...
for unintended consequences. These scenarios pertain to the possibility that the new recommendation will have a disruptive effect on current routines and resources. First, with respect to capacity, we noted a recent study by Joseph et al exploring whether screening capacity was sufficient to fulfill the National Colorectal Cancer Roundtable (NCCRT) goal for the nation of 80% screening by 2018. Over a period from 2014 to 2040, a colonoscopy-only scenario would require from 11 to 13 million colonoscopies annually, with an additional capacity of up to 10.5 million colonoscopies available. Some confidence can be derived from these results; however, throughout the United States, there are areas in which a colonoscopy is not easily obtained, and large segments of the target population do not have access because they are uninsured or underinsured. Thus, whereas capacity estimates suggest that, in most settings, capacity is adequate to expand the size of the target population, it is prudent to be concerned about the possibility that the diversion of resources and the existing disparities may be worsened in some areas. The ACS is committed to identifying and working to resolve areas in which there are disparities in access to care.

The USPSTF currently recommends screening for CRC starting at age 50 years and continuing until age 75 years (A recommendation). Similar to the 2018 ACS recommendation, the USPSTF states that the decision to screen for CRC in adults aged 76 to 85 years should be an individual one, taking into account the patient’s overall health and prior screening history (C recommendation). Instead of emphasizing specific approaches to screening, the USPSTF chose to emphasize the evidence for the effectiveness of CRC screening and that too few adults are undergoing regular screening. Information on the characteristics of CRC screening strategies (gFOBT, FIT, FIT-DNA, colonoscopy, CT colonography, flexible sigmoidoscopy, and flexible sigmoidoscopy with FIT) was provided in the recommendation statement.

In 2017, the USMSTF updated their recommendations for CRC screening. In the update, the USMSTF recommended adults at average risk for CRC begin annual screening for CRC at age 50 years but that African Americans initiate routine screening at age 45 years. The USMSTF also recommended discontinuation of screening upon reaching age 75 years for those who have prior negative screening or those with less than 10 years of life expectancy. The USMSTF listed recommended screening methods using a new ranked approach that divides screening methods into 3 tiers based on performance features, costs, and other considerations. First-tier tests (colonoscopy every 10 years and annual FIT) are considered the cornerstone of screening. Second-tier tests include CT colonography every 5 years, a multitarget stool DNA test every 3 years, and flexible sigmoidoscopy every 5 to 10 years. Capsule colonoscopy every 5 years is the sole third-tier test.

**CRC in Younger Individuals**

Recent reports indicated that the risk of CRC decreased sequentially for birth cohorts from 1890 to 1950 but has increased for every generation born since 1950. The age-specific risk of colon cancer for an individual born in 1990 is double that of someone born in 1950; for rectal cancer, the risk has quadrupled. The underlying causes for the increased incidence of early-onset CRC are not fully understood, but recognized risk factors may play an important role. A higher fraction of individuals with early-onset disease has a family history of CRC or a risk-inducing genetic mutation compared with adults aged 50 years and older. Several other known CRC risk factors also are likely contributing to early-onset disease, including increasing trends in obesity, the prevalence of type II diabetes mellitus, and a sedentary lifestyle. Consumption of processed and red meats and increased prevalence of inflammatory bowel disease may also be factors.

Delay in diagnosis is a common and concerning feature of young-onset CRC. One study indicated that the median time to initial clinical presentation after the onset of symptoms was twice as long for patients with early-onset CRC compared with older patients (60 days vs 30 days), and that patients with early-onset CRC experienced a longer time to diagnosis after symptom recognition (128 days vs 79 days). A study of patients with rectal cancer indicated that the time from symptom onset to treatment was more than 4 times longer for patients younger than 50 years (217 days) compared with adults aged 50 years and older (58 days). This delay may be caused by failure on the part of both patients and primary care clinicians to consider CRC as a potential cause of symptoms, resulting in a less aggressive diagnostic approach than that taken in older individuals who present with similar symptoms.

Efforts are underway to better understand the interplay between molecular-genetic factors and environmental/behavioral risks and to use this information to enhance risk assessment and intervention. Recognition of at-risk individuals will require better collection and utilization of family history information and will be enhanced by routine genetic testing with a comprehensive cancer gene panel for all patients with early-onset CRC. There is a need to raise awareness among clinicians and the public of the increased prevalence of CRC in young and middle-aged adults and to encourage prompt and thorough evaluation of symptomatic patients (ie, those with rectal bleeding, unexplained weight loss, abdominal pain, etc) regardless of age.

**Recommendations for High-Risk Adults**

The ACS and other organizations recommend more intensive surveillance for individuals at higher risk for CRC. Those at higher risk for CRC include
individuals: 1) with a history of adenomatous polyps; 2) with a personal history of curative-intent resection of CRC; 3) with a family history of either CRC or advanced adenomas diagnosed in a first-degree relative (with consideration of the relative’s age at diagnosis); 4) with a known or suspected presence of hereditary syndromes, especially Lynch syndrome or familial adenomatous polyposis (FAP); 5) at significantly higher risk because of a history of inflammatory bowel disease of significant duration; 6) with a history of abdominal or pelvic radiation for a previous cancer; and 7) with cystic fibrosis. For these individuals, screening or increased surveillance generally means a specific recommendation for colonoscopy if available and may include more frequent examinations and starting examinations at an earlier age.

There is a need for improvement in the knowledge and implementation of these high-risk screening recommendations by clinicians. A larger proportions of patients with CRC at a young age have a family history of CRC (25% vs 17% in older patients) and a confirmed or probable hereditary cancer syndrome (7% vs 1% in older patients). These risk factors are often not recognized until patients are diagnosed with CRC, representing missed opportunities for prevention and early detection. The risk of CRC and early-onset CRC is significantly higher in persons with a family history than in the general population, but less than one-half of these individuals are adherent with risk-based screening guidelines, often because of lack of awareness and guidance attributable to failure to assess the patient’s family history.

Follow-Up Colonoscopy After a Positive Noncolonoscopy Screening Test

Although the ACS guideline (and the USPSTF recommendations) emphasizes choice among screening test options, most CRC screening in the United States is completed with colonoscopy, and all adults screened with other testing options who have a positive test result should undergo further evaluation with colonoscopy to complete the screening examination. Appropriate follow-up of abnormal stool test findings is a key component of high-quality screening and is included in the recommendation wording of the 2018 ACS guideline. Stool tests serve as the first step of a 2-step screening process, wherein step 2 is an evaluation of all positive gFOBTs or FITs with colonoscopy. The screening process is not complete until the patient undergoes a colonoscopy to determine whether the abnormal stool test result signals the presence of a cancer, an advanced adenomatous polyp, or other pathology. For this reason, CRC screening guidelines from all organizations recommend colonoscopy after a positive stool test. Yet colonoscopy follow-up of positive stool blood test results is highly variable, and delays and outright failures to perform follow-up colonoscopy have been widely documented. One study comparing completion rates among 4 health systems in the United States indicated that the rates of colonoscopy follow-up at 12 months varied from as low as 58% up to 83%, revealing a wide range of follow-up rates and a need for improvement among both the lowest and the highest performing systems. May et al assessed factors associated with a 38% lack of follow-up colonoscopy within 6 months in a Veterans Affairs cohort undergoing FIT. The factors associated with lack of colonoscopy were grouped into 4 categories: patient-related (49%), which included declining colonoscopy, missed appointment, and lack of transportation; provider-related (16%), which included the provider having discovered a recent colonoscopy or a repeat FIT test with negative findings (neither is a defensible basis for failure to have follow-up colonoscopy); system-related (12%), which principally were scheduling challenges; and multifactorial reasons (22%). These findings point to the importance of identifying the specific factors associated with lack of follow-up in health settings and the application of tailored interventions that address each targeted barrier. The importance of complete follow-up is underscored by the findings of Lee et al, who observed that the risk of CRC and advanced disease increased with the duration of time before the follow-up examination and that FIT-positive patients who did not receive follow-up colonoscopy had a 1.64-fold increased risk of CRC death compared with FIT-positive patients who did receive follow-up. Douten et al reported similar findings from a retrospective cohort study of patients in the Kaiser Permanente Northern and Southern California systems who died of CRC from 2006 to 2012. Whereas approximately three-fourths of the deaths from CRC were associated with not being up to date on screening, one-fourth occurred in patients who were current with screening recommendations. Among all CRC deaths, 8.1% were attributable to failure to follow-up a positive screening test. A recent review of interventions to improve follow-up colonoscopy after a positive stool test indicated that patient navigators and provider feedback may improve timely follow-up, but evidence for other system-level interventions was unclear.

The National Colorectal Cancer Roundtable’s 80% by 2018 Campaign

In 2014, the NCCRT, an organization established by the ACS and the CDC in 1996, launched an ambitious national campaign to increase CRC screening rates to 80% by 2018. The goal was motivated by the optimism that access to screening would be substantially improved under the Patient Protection and Affordable Care Act, recent trends in declining CRC incidence and mortality that were largely attributable to screening, the significant fraction of the target population that was unscreened, and the potential to prevent an estimated 203,000 deaths from CRC by 2030.
Testing for Early Prostate Cancer Detection

Prostate cancer is the most common cancer, apart from skin cancer, diagnosed in men in the United States, with an estimated 174,650 new cases and 31,620 deaths expected in 2019. Overall, prostate cancer incidence and mortality rates have been declining in both black and white men since the early 1990s, but age-adjusted incidence rates among black men remain 75% higher than in non-Hispanic white men, and mortality rates are more than twice as high.

The current ACS guideline for the early detection of prostate cancer was published in 2010 and states that men who have at least a 10-year life expectancy should have an opportunity to make an informed/shared decision with their health care provider about whether to be screened for prostate cancer with serum prostate-specific antigen (PSA), with or without DRE, after receiving information about the benefits, risks, and uncertainties associated with prostate cancer screening and therapy (see Table 3).

Prostate cancer screening should not occur without an informed decision-making process. Men at average risk should receive this information beginning at age 50 years. Men at higher risk, including African American men and men with a family member (father or brother) who was diagnosed with prostate cancer before age 65 years, should receive this information beginning at age 45 years. Men at appreciably higher risk (multiple family members diagnosed with prostate cancer before age 65 years) should receive this information beginning at age 40 years. Men should either receive this information directly from their health care provider or be referred to reliable and culturally appropriate sources. Patient decision aids are helpful in preparing men to make a decision whether to be tested. For men who are unable to decide, the screening decision can be left to the discretion of the health care provider, who should factor into the decision his or her knowledge of the patient’s general health preferences and values. Asymptomatic men who have less than a 10-year life expectancy based on age and health status should not be offered prostate cancer screening. For men who choose to be screened for prostate cancer after a process of shared or informed decision making: 1) screening is recommended with the PSA test with or without the DRE (DRE is recommended along with PSA for men with hypogonadism because of reduced sensitivity of PSA); 2) for men whose PSA is less than 2.5 ng/mL, screening intervals can be extended to every 2 years, and screening should be conducted yearly for men whose PSA level is 2.5 ng/mL or higher; and 3) a PSA level of 4.0 ng/mL or higher has historically been used to recommend referral for further evaluation or biopsy, which remains a reasonable approach for men who are at average risk for prostate cancer. For men with PSA levels between 2.5 and
TABLE 3. Core Elements of the Information To Be Provided to Men to Assist With Their Decision About Prostate Cancer Screening

| Prostate cancer is an important health concern for men: |
|-------------------------------------------------------|
| • Screening with the PSA blood test alone or with both the PSA test and DRE detects cancer at an earlier stage than if no screening is performed |
| • Prostate cancer screening may be associated with a reduction in the risk of dying from prostate cancer; however, evidence is conflicting, and experts disagree about the value of screening |
| • For men whose prostate cancer is detected by screening, it is currently not possible to predict which men are likely to benefit from treatment; some men who are treated may avoid death and disability from prostate cancer; others who are treated would have died of unrelated causes before their cancer became serious enough to affect their health or shorten their lives |
| • Depending on the treatment selected, treatment of prostate cancer can lead to urinary, bowel, sexual, and other health problems; these problems may be significant or minimal, permanent or temporary |
| • The PSA and DRE may have false-positive or false-negative results, meaning that men without cancer may have abnormal results and get unnecessary additional testing, and clinically significant cancers may be missed; false-positive results can lead to sustained anxiety about prostate cancer risk |
| • Abnormal results from screening with the PSA or DRE require prostate biopsies to determine whether or not the abnormal findings are cancer; biopsies can be painful, may lead to complications such as infection or bleeding, and can miss clinically significant cancer |
| • Not all men whose prostate cancer is detected through screening require immediate treatment, but they may require periodic blood tests and prostate biopsies to determine the need for future treatment |
| • In helping men to reach a screening decision based on their personal values, once they understand the uncertainties, risks, and potential benefits, it can be helpful to provide reasons why some men decide for or against undergoing screening; for example: |
| o A man who chooses to be screened might place a higher value on finding cancer early, might be willing to be treated without definite expectation of benefit, and might be willing to risk injury to urinary, sexual, and/or bowel function |
| o A man who chooses not to be screened might place a higher value on avoiding the potential harms of screening and treatment, such as anxiety or risk of injury to urinary, sexual, or bowel function |

Abbreviations: DRE, digital rectal examination; PSA, prostate-specific antigen.

4.0 ng/mL, health care providers should consider an individualized risk assessment that incorporates other risk factors for prostate cancer, particularly for high-grade cancer, which may be used for a referral recommendation. Factors that increase the risk of prostate cancer include African American race, family history of prostate cancer, increasing age, abnormal DRE, and high age-specific PSA level. A prior negative biopsy lowers risk. Methods are available that merge this information to achieve an estimate of a man’s overall risk of prostate cancer and, more specifically, his risk of high-grade prostate cancer. These risk-stratification/decision-making algorithms are intended to increase the benefit of testing and reduce the harms associated with biopsy and treatment of low-risk prostate cancer. For example, a widely used risk calculator, the Prostate Cancer Prevention Trial (PCPT) Prostate Cancer Risk Calculator, which was first available in 2006 and was updated in 2012 to include the ability to predict risk of low-grade (Gleason grade <7) versus high-grade prostate cancer, can aid decisions about biopsy and other procedures. The calculator is based on findings from nearly 6000 men in the placebo arm who were followed annually with PSA and DRE, most of whom underwent biopsy at the end of the trial regardless of prior PSA and DRE findings. The calculator is applicable to men aged 55 years and older without a prior diagnosis of prostate cancer who have DRE and PSA results less than a year old. An alternative approach to risk stratification that integrates age, age-specific PSA levels, and risk factors into prostate cancer screening recommendations and consideration of referral for biopsy has been proposed by investigators at the Memorial Sloan Kettering Cancer Center. Prostate cancer screening recommendations have been influenced by the conflicting results from 2 large, prospective RCTs of prostate cancer screening that were published in 2009. A large European RCT, the European Randomized Study of Screening for Prostate Cancer, observed a statistically significant prostate cancer mortality reduction (21%) associated with invitation to prostate cancer screening, whereas a large US RCT, the Prostate, Lung, Colorectal, and Ovarian Screening (PLCO) trial, observed no reduction in prostate cancer mortality associated with an invitation to screening. A collaborative investigation involving the trial investigators and a group of independent researchers sought to reconcile the differences in the observed mortality reductions between the 2 studies in terms of their implementation and practice settings and the intensity of screening. The intensity of screening is an important difference between the 2 studies because of a very high rate of control-group contamination in the US study. The investigators estimated the intensity of screening in each study group and the mean lead time gained in each arm of the 2 trials. After adjustment for screening intensity and the influence of the mean lead time in reducing the risk of prostate cancer death, they observed
similar estimates in the reduction of the expected risk of prostate cancer death in each study setting over 11 years of follow-up (ie, 25% to 31% in the European Randomized Study of Screening for Prostate Cancer and 27% to 32% in the PLCO trial). Although these findings provide persuasive evidence that PSA screening is associated with a reduction in prostate cancer mortality, the challenge of identifying aggressive versus indolent disease and the significant rate of serious complications after prostate cancer treatment still warrant recommendation for shared decision making rather than a direct recommendation for screening.

In 2018, the USPSTF published updated recommendations on screening for prostate cancer with the PSA blood test. On the basis of a review of the evidence addressing a wide range of prostate cancer-related issues, the USPSTF concluded that there is a small net benefit of PSA-based screening for prostate cancer in some men aged 55 to 69 years, and that “the decision to undergo periodic PSA-based screening should be an individual one and should include discussion of the potential benefits and harms of screening with their clinician” (C recommendation). The USPSTF continues to recommend against PSA-based screening for prostate cancer in men aged 70 years and older (D recommendation) in large part because of the increased risk of harms from false-positive PSA results, biopsies, overdiagnosis, and treatment in men of advanced age.

The systematic evidence review that formed the basis for the 2018 USPSTF recommendations indicated that PSA-based screening programs in men aged 55 to 69 years may prevent approximately 1.3 deaths from prostate cancer over approximately 13 years per 1000 men screened and may prevent 3 cases of metastatic prostate cancer per 1000 men screened.

The USPSTF recommendation statement acknowledges that, given the higher rates of aggressive prostate cancer in African American men, PSA-based screening may provide greater benefit to African American men than to men in the general population. They also recognize that men who have a first-degree relative who had advanced prostate cancer at diagnosis, developed metastatic prostate cancer, or died of prostate cancer are probably the most likely to benefit from screening. However, the USPSTF review concluded that there is inadequate evidence to determine whether the balance of benefits and harms of PSA-based screening may be different for men who are at higher risk of developing prostate cancer or whether beginning screening at an earlier age may have value for such men.

The 2018 recommendation reverses the recommendation issued in 2012, when the USPSTF assessment of the evidence indicated that the harms of PSA testing outweighed the benefits and recommended against PSA-based screening for all men (D recommendation). In the 2018 update, the USPSTF cites factors that have arisen since 2012 that contributed to the change in their 2018 recommendation, including additional evidence supporting the impact of PSA-based screening on reductions in the risk of dying of prostate cancer and the risk of metastatic disease, as well as indications of a 4-fold increase in the use of active surveillance among men with low-risk prostate cancer (from about 10% in 2005-2009 to 40.4% in 2010-2013), which may reduce the risk of subsequent harms from screening.

No major medical organization in the United States recommends prostate cancer screening for all average-risk men because of the significant risk of overdiagnosis incurred with the use of PSA-based screening and the relatively common harms associated with treatment of prostate cancer. The USPSTF review estimated that long-term erectile dysfunction will occur in approximately 2 in 3 men who undergo radical prostatectomy and more than one-half of men who receive radiation therapy; 1 in 5 men will experience persistent urinary incontinence after surgery; and 1 in 6 men who receive radiation will experience bothersome bowel symptoms, including bowel urgency and fecal incontinence.

The focus on informed decision making reflected in the current USPSTF recommendation is similar to prostate cancer early detection recommendations from the ACS and those of several other organizations, including the American College of Physicians and the American Urological Association. Providing support to men in facilitating informed and values-consistent decisions about prostate cancer early detection remains a challenge for practitioners and health care organizations in all settings.

Screening for Endometrial Cancer

In 2019, the ACS estimates that 61,880 women will be diagnosed with, and 12,160 women will die from, uterine corpus cancers (approximately 92% of which are endometrial carcinomas). Uterine corpus cancer incidence has increased by 1.3% per year between 2006 and 2015, and mortality rates similarly increased during this period. In 2001, the ACS concluded that there was insufficient evidence to recommend screening for endometrial cancer in women at average risk or at increased risk because of a history of unopposed estrogen therapy, tamoxifen therapy, late menopause, nulliparity, infertility or failure to ovulate, obesity, diabetes, or hypertension. The ACS recommends that women at average and increased risk should be informed about the risks and symptoms (in particular, unexpected bleeding and spotting) of endometrial cancer at the onset of menopause and should be strongly encouraged to immediately report these symptoms to their physicians (Table 2). Women at very high risk for endometrial cancer because of 1) known Lynch syndrome genetic mutation carrier status, 2) a substantial likelihood of being a mutation carrier
Women at high risk should be informed that the limitations of testing for early endometrial cancer detection should be informed about the potential benefits, harms, and limitations of testing for early endometrial cancer detection at age 35 years. The evaluation of endometrial histology with an endometrial biopsy is still the standard for determining the status of the endometrium. Women at high risk should be informed that the recommendation for screening is based on expert opinion, and they also should be informed about the potential benefits, harms, and limitations of testing for early endometrial cancer detection.

Screening for Lung Cancer

Lung cancer is the most common cancer affecting both men and women, accounting for an estimated 228,150 new cases in 2019. Lung cancer also is the leading cause of death from cancer in men and women, accounting for an estimated 142,670 deaths in 2019, which is approximately 25% of all cancer deaths in the United States. Trends in lung cancer incidence and mortality vary by gender. Incidence rates in men have been declining since the 1980s; and, between 2011 and 2015, the average age-adjusted and delay-adjusted incidence rates declined by 2.9% per year. For women, declines in incidence lagged behind those of men. Incidence rates in women did not begin declining until the mid-2000s as a result of differences in smoking uptake and cessation patterns but, between 2011 and 2015, the average age-adjusted and delay-adjusted incidence rates declined by 1.5% per year. Among men, mortality rates have declined by 45% since 1990 and, among women, mortality rates have declined by 19% since 2002.

The ACS recommendation for lung cancer screening is based on randomized trial evidence of screening efficacy in reducing lung cancer mortality and a judgment that the balance between potential benefits and harms is favorable. The recommendation also affirms the conditions under which screening should take place: that individuals are appropriately selected, that patients are provided information to gain an understanding of the screening process and possible outcomes, and that they have access to high-quality screening and follow-up. The 2013 guideline statement placed a high priority on smoking cessation counseling for current smokers who were considering screening as one of the core elements of the discussion about lung cancer screening. In the 2017 clarification and update, the importance of smoking cessation counseling was stated more clearly as an important element in the process of identifying high-risk adults who are eligible for lung cancer screening.

Most organizations that have issued lung cancer screening guidelines follow the age and risk study eligibility criteria requirements for the National Lung Screening Trial (NLST), although, where exceptions exist, differences mostly are in the age at which to stop screening and modifications in minimum smoking history in the presence of additional risk factors. The USPSTF...
Cancer Screening in the US, 2019

The Centers for Medicare & Medicaid Services covers lung cancer screening for Medicare beneficiaries according to the NLST criteria but extends screening coverage to age 77 years. The National Comprehensive Cancer Network (NCCN) recommends annual lung cancer screening according to the NLST criteria for adults who do not have additional risk factors for lung cancer (group 1). The NCCN does not specify a specific stopping age, stating that an adult undergoing screening should continue screening until they are no longer candidates for definitive treatment. The NCCN recommends that adults who have additional risk factors for lung cancer (group 2), such as personal history of other cancers or lung disease (chronic obstructive pulmonary disease and diffuse pulmonary fibrosis), family history of lung cancer, radon exposure, and occupational exposure to carcinogens that elevate their 5-year risk above 1.3%, should begin screening at age 50 years if they have at least a ≥20-pack-year history. Group 2 patients who are former smokers also should continue to undergo screening regardless of time since quitting.

Long-awaited results from the NELSON trial (a Dutch acronym for Nederlands-Leuvenkanker Screenings ONderzoek), an RCT of lung cancer screening in the Netherlands, were reported at the International Association for the Study of Lung Cancer’s 19th World Conference on Lung Cancer in Toronto, Canada. Similar to the NLST, the investigators observed a statistically significant reduction in lung cancer deaths in a group of high-risk current and former smokers who were invited to lung cancer screening compared with a similar group that received usual care. These results, as of now unpublished, add to the scientific evidence demonstrating the value of lung cancer screening in reducing lung cancer deaths. Given the strong evidence of the efficacy of lung cancer screening in high-risk current and former smokers, identifying adults who meet screening criteria is a high public health priority. The most recent data indicate that 79% of lung cancers still are diagnosed as regional or distant disease, for which 5-year survival is very poor (30% for regional disease, and 5% for distant disease).

The most recent evidence indicates that uptake of lung cancer screening is low. The NHIS began collecting data on lung cancer screening in 2010, the year that results of the NLST were announced, but approximately 10 years after a comparison of chest x-ray with LDCT demonstrated significantly greater sensitivity for the detection of small lung cancers was reported in the literature, and LDCT began to be promoted. In 2010, 3.3% of adults who met USPSTF criteria reported having had an LDCT for lung cancer screening in the past year, and in 2015, this proportion was similar at 3.9% (Table 5). Table 5 shows reported lung cancer screening rates in 2015 by race/ethnicity, health insurance status among adults aged <64 years, and education.

The implementation of high-quality lung cancer screening faces numerous challenges, and the low uptake of screening to date should be understood as not dissimilar to the early low uptake of other screening tests but also in the context of the greater logistical challenges faced by referring physicians. Although results of the NLST were published in 2011, coverage for lung cancer screening under the Patient Protection and Affordable Care Act was not available until 2015, and although Centers for Medicare & Medicaid Services coverage also was established in 2015, procedural and reimbursement issues took longer to resolve. Compared with other cancer screening tests, the requirements for determination of screening eligibility, shared decision-making discussions, and coordinating with specialists place new and greater demands on the primary care provider. Lung cancer screening is unique in that the target population is defined by both age and a behavioral risk factor. Identifying adults who are eligible for screening and conducting shared decision making add an additional burden on primary care providers, who must be given the tools and the incentives to fulfill their important role. Electronic health records should enable the identification of adults who meet tobacco exposure and other eligibility requirements, but early experience has demonstrated that they perform poorly, resulting in an additional burden when health care professionals need to interview patients to assess pack-year history.

Furthermore, as smoking has become increasingly concentrated in lower socioeconomic populations, greater barriers to access are experienced by adults who comprise the target population for lung cancer screening compared with other screening tests. Jemal and Fedewa reported that over 50% of current and former smokers who met USPSTF criteria in 2015 were uninsured or Medicaid-insured. In addition, it will take time to establish increased awareness among health care professionals and adults at risk, as well as to integrate referral routines into daily practice.

It may be some years before the influence of increasing prevalence of lung cancer screening on lung cancer mortality rates will be evident, not only because of the slow pace of integration of risk assessment and screening referral in primary care but also because of the need to include indicators of routine lung cancer screening in national population-based surveys of recent preventive care.

In 2017, the ACS launched the National Lung Cancer Roundtable (NLCRT) to engage key organizations in the common mission of reducing incidence, morbidity, and mortality from lung cancer among current and former smokers through age-appropriate and risk-appropriate, high-quality screening, tobacco treatment, smoking abstinence, improved...
management of positive findings, and improved triage of adults with a diagnosis of lung cancer. Goals/outcomes include: 1) improved awareness in the population at risk; 2) improved risk assessment and identification of adults at high risk for lung cancer, competent conversations about lung cancer screening with eligible adults, and referral to screening; 3) increased enrollment and participation in American College of Radiology-designated lung screening center programs and the American College of Radiology Lung Cancer Screening Registry; 4) improved lung screening and diagnosis technology and interpretative skills; 5) improved assessment of smoking status, improved tobacco treatment, and support for abstinence; and 6) improved postdiagnosis care, including guideline-recommended genetic testing, surgical staging, and triage for appropriate treatment. Other initiatives identified by the Steering Committee that are well suited for NLCRT attention are initiatives focused on lung cancer in women, health services and policy issues, enhanced survivorship, overcoming stigma, and support for state-based lung cancer initiatives. Additional information on the membership, goals, and activities of the NLCRT is available at its website (nlcrt.org).

Table 5. Prevalence (%) of Recent Cancer Screening Examinations Among US Adults: National Health Interview Survey, 2015

| Screening Examination                              | 2005* | 2008* | 2010* | 2013* | 2015 | ABSOLUTE % CHANGE 2015 TO 2005 | ABSOLUTE % CHANGE 2015 TO 2013 |
|--------------------------------------------------|-------|-------|-------|-------|------|-------------------------------|-------------------------------|
| Colorectal cancer (adults aged ≥50 y)            |       |       |       |       |      |                               |                               |
| Endoscopy                                       | 46.8  | 53.2  | 56.4  | 55.9  | 60.3 | 13.5                          | 4.4                           |
| Stool-based test                                 | 12.1  | 10.0  | 8.8   | 7.8   | 7.2  | −4.9                          | −0.6                          |
| Stool-based test or endoscopy                   | 43.1  | 50.2  | 59.1  | 58.6  | 62.6 | 19.5                          | 4.0                           |
| Breast cancer (women aged ≥40 y)                |       |       |       |       |      |                               |                               |
| Mammogram within the preceding y                | 51.2  | 53.0  | 50.8  | 51.3  | 50.2 | −1.0                          | −1.1                          |
| Mammogram within the preceding 2 y              | 66.5  | 67.1  | 66.5  | 65.9  | 64.3 | −2.2                          | −1.6                          |
| Cervical cancer (women aged 21-64 y)            |       |       |       |       |      |                               |                               |
| Pap test                                        | 85.4  | 84.6  | 83.1  | 80.9  | 81.6 | −3.8                          | 0.7                           |
| Lung cancer                                      | —     | —     | 3.3   | —     | 3.9  | 0.6                           | —                             |
| Low-dose CT                                      | —     | —     | —     | —     | —    |                               |                               |

Abbreviations: CT, computed tomography; Pap test, Papanicolaou test.
Source: National Health Interview Survey 2005, 2008, 2010, 2013, and 2015 (National Center for Health Statistics, Centers for Disease Control and Prevention, Atlanta, GA).
*Prevalence estimates for 2005, 2008, 2010, and 2013 are shown here to describe differences in the absolute percentage change in cancer screening use with respect to the most recent data (2015). Prevalence is weighted and age-adjusted using the 2000 Census.
†Either sigmoidoscopy within the preceding 5 years or colonoscopy within the preceding 10 years.
‡Either a fecal occult blood test or a fecal immunochemical test using a home test kit performed within the preceding year (2015 estimates include the fecal immunochemical test, but prior years do not).
§A stool-based test or an endoscopy within the preceding year, or sigmoidoscopy within the preceding 5 years, or colonoscopy within the preceding 10 years.
ªWomen with intact uteri who had a Pap test within the preceding 3 years. Estimates shown here for 2005, 2008, 2010, and 2013 differ slightly from data presented previously because of differences in the age categories presented.
¶Low-dose CT scans obtained among high-risk smokers, defined as individuals aged 55 to 80 years with a ≥30–pack-year smoking history and who currently smoke or have quit within the past 15 years.

Testing for Early Ovarian Cancer Detection

Although the annual incidence of ovarian cancer is low compared with other cancers for which screening is recommended to women, approximately 22,530 women will be diagnosed with ovarian cancer in 2019, and 13,980 will die from the disease. Fewer than one-half of women diagnosed with ovarian cancer survive longer than 5 years and, although the 5-year survival of women with localized ovarian cancer is greater than 90%, only 15% of all patients are diagnosed with localized disease.

Currently, no organization recommends screening average-risk women for ovarian cancer. Screening and diagnostic methods for ovarian cancer include pelvic examination, cancer antigen 125 (CA 125) as a tumor marker, transvaginal ultrasound (TVU), and potentially multimarker panels and bioinformatic analysis of proteomic patterns. In their 2018 update of the 2012 ovarian cancer screening recommendation statement, the USPSTF recommended against screening for ovarian cancer (D recommendation) for asymptomatic, average-risk women not known to have a high-risk hereditary cancer syndrome, concluding that there was adequate evidence that screening with TVU, CA 125, or a combination of
both does not reduce ovarian cancer mortality and that there was adequate evidence that screening for ovarian cancer can lead to moderate and even substantial harms, mainly because of false-positive findings and surgical interventions in women without ovarian cancer. The recommendation was largely based on negative results from the UK Collaborative Trial of Ovarian Cancer Screening (UKCTOCS) and the US PLCO trial.

Although the PLCO and UKCTOCS trials both screened women using CA 125, the PLCO trial used a fixed threshold measure of CA 125 annually in combination with TVU, whereas the UKCTOCS had 2 intervention groups, one that was invited to screening with a multimodal screening strategy (MMS) that included annual CA 125 screening using a risk of ovarian cancer algorithm and TVU as a second-line test, and a second intervention group that was invited to screening with ultrasound alone. The risk of ovarian cancer algorithm measures changes in CA 125 over time above a baseline measure rather than with a single cutoff point, as has been used traditionally and in the PLCO study and has shown improved sensitivity for smaller cancers without measurably increasing the false-positive rate. The initial analysis of trial data has demonstrated nonsignificant mortality reductions over years 0 through 14 of 15% (95% CI, −3 to 30; \( P = .10 \)) associated with MMS and 11% (95% CI, −7 to 27; \( P = .21 \)) associated with TVU. More favorable findings were observed if prevalent cases were censored and for cases diagnosed in years 7 through 14 of the study. The authors cautioned that further follow-up needed was needed before policy decisions about the value of MMS ovarian cancer screening could be considered.

**Surveillance of Cancer Screening: Colorectal, Breast, Cervical, Prostate, and Lung Cancers**

In this update, we provide the most recent national screening data from the NHIS, a nationally representative, in-person household survey that includes questions regarding cancer screening every 2 to 3 years. The most recent data available are from the 2015 NHIS and were included in the 2017 and 2018 annual reviews of cancer screening published in this journal. Here, we include these basic data for reference (Table 5), but readers should refer to the prior articles for greater detail.

Although CRC screening increased from 2005 to 2015 (from 46.8% to 62.6%), the trend in rates for other recommended screening tests either remained stable or declined, and, with the exception of screening rates for CRC, levels still fall short of national goals set by the US Department of Health and Human Services’ Healthy People 2020 Objectives. Cervical cancer screening prevalence declined slightly between 2005 and 2015 from 85.4% to 81.6%, and there has been little change in breast cancer screening since 2005. We are not able to measure shared decision making for prostate cancer over time, which is the predominant recommendation from groups that have issued prostate cancer screening recommendations. Reported prostate cancer screening rates were stable between 2005 and 2010, declined by 18% between 2010 and 2013 (from 37.8% to 30.8%) according to NHIS data, and have remained stable between 2013 and 2015. Nationwide studies indicate that only 36% of men report shared decision making for prostate cancer screening, and discussions are often inadequate and fail to fully address the benefits, risks, and uncertainties of PSA testing. There are limited data on LDCT for lung cancer screening in community practice. A recent ACS study using 2010 and 2015 NHIS data estimated that the proportion of high-risk current and former smokers (who quit in the past 15 years) who had undergone LDCT for lung cancer screening in the past year did not change and remained at less than 4%.

We examined the collective prevalence of breast cancer, cervical cancer, and CRC screening among female respondents in the 2015 NHIS who were eligible (aged 50–65 years) for all 3 tests (Tables 6 and 7) and of CRC and prostate cancer screening among male respondents in the same age range (Tables 8 and 9). Although guidelines for prostate cancer screening recommend shared decision making, here, we examine the pattern of recent use of CRC and prostate cancer screening tests or the use of just one.

Approximately 42.1% of women received all 3 screening tests, 17.4% received breast and cervical screening only, 10.9% received none, and the remaining 29.9% received either a single test or tests for CRC along with screening for breast or cervical cancer (Table 6). The proportion of women who were up-to-date with all 3 screening tests was markedly lower among Hispanic (34.0%) and Asian (34.4%) women than among black (40.9%) and white (44.3%) women. Receipt of cervical and breast cancer screening only (and not CRC screening) was relatively common (17.4%), especially among Hispanic women, of whom over one-fourth (26.6%) had received breast and cervical cancer screening, but not CRC screening. If Hispanic women who were up to date with mammography and Pap testing were also up to date with CRC testing, their rates of all 3 screening tests would catch up to those of whites.

Among men, approximately 28.9% reported receiving CRC screening and prostate cancer screening, 33.5% reported only CRC screening, 6.7% reported only prostate cancer screening, and 30.8% reported no recent cancer screening (Table 8). Among all men who underwent CRC screening, a higher percentage of white men also received PSA testing (48%) compared with black men (44%) and Hispanic men (40%).
### TABLE 6. Breast, Colorectal, and Cervical Cancer Screening by Race/Ethnicity Among Women Aged 50 to 65 Years, National Health Interview Survey, 2015

|                     | TOTAL   | HISPANIC | NHW     | BLACK   | ASIANa  |
|---------------------|---------|----------|---------|---------|---------|
|                     | %       | 95% CI   | %       | 95% CI  | %       | 95% CI  | %       | 95% CI  | %       | 95% CI  |
| CRC, breast, and cervical | 42.1    | 40.2     | 44.0    | 44.3    | 42.0    | 46.7    | 40.9    | 36.1    | 45.9    | 34.4    | 26.5    | 43.3    |
| Breast and cervical only | 17.4    | 16.0     | 19.0    | 15.1    | 13.4    | 17.0    | 21.2    | 17.5    | 25.3    | 19.7    | 14.2    | 26.6    |
| CRC and breast only  | 7.9     | 6.8      | 9.1     | 8.1     | 6.8     | 9.6     | 7.6     | 5.2     | 10.9    | a       | a       | a       |
| CRC and cervical only | 6.4     | 5.5      | 7.5     | 6.9     | 5.8     | 8.3     | 5.8     | 4.1     | 8.1     | a       | a       | a       |
| CRC only             | 4.4     | 3.7      | 5.2     | 5.0     | 4.1     | 6.1     | 2.7     | 1.7     | 4.4     | a       | a       | a       |
| Breast only          | 3.9     | 3.2      | 4.8     | 3.7     | 2.9     | 4.8     | 4.4     | 2.8     | 6.9     | a       | a       | a       |
| Cervical only        | 7.0     | 6.1      | 8.0     | 6.4     | 5.3     | 7.8     | 7.1     | 4.8     | 10.3    | a       | a       | a       |
| None                 | 10.9    | 9.8      | 12.2    | 10.4    | 9.0     | 12.0    | 10.4    | 7.9     | 13.7    | 13.4    | 8.8     | 20.0    |

Abbreviations: 95% CI, 95% confidence interval; CRC, colorectal cancer; NHW, non-Hispanic white.

aEstimates are unstable (the relative standard error exceeded 30%).

### TABLE 7. Breast, Colorectal, and Cervical Cancer Screening by Education Among Women Aged 50 to 65 Years, National Health Interview Survey, 2015

|                     | TOTAL   | LESS THAN HIGH SCHOOL | HIGH SCHOOLa | SOME COLLEGE | COLLEGE |
|---------------------|---------|-----------------------|--------------|--------------|--------|
|                     | %       | 95% CI                | %            | 95% CI       | %      |
| CRC, breast, and cervical | 42.0    | 40.0 44.0              | 26.6 22.2 31.4 | 35.1 31.2 39.1 | 43.5 40.0 47.1 |
| Breast and cervical only | 17.9    | 16.3 19.6             | 20.2 16.0 25.2 | 19.2 15.9 23.0 | 16.5 14.0 19.4 |
| CRC and breast only  | 7.7     | 6.6 8.9               | 6.9 4.2 11.0  | 7.4 5.5 9.8   | 7.9 6.2 10.0  |
| CRC and cervical only | 6.4     | 5.5 7.5               | 4.8 3.0 7.6  | 8.1 5.9 10.9 | 6.8 5.2 8.8  |
| CRC only             | 4.1     | 3.4 5.0               | 4.3 2.5 7.5  | 5.0 3.7 6.7  | 4.3 3.0 6.2  |
| Breast only          | 3.9     | 3.1 4.7               | 6.0 3.8 9.2  | 5.4 3.7 7.7  | 2.8 1.9 4.0  |
| Cervical only        | 7.2     | 6.2 8.3               | 9.0 6.0 13.1 | 7.1 5.4 9.2  | 6.8 5.2 8.9  |
| None                 | 10.9    | 9.7 12.2              | 22.3 18.0 27.3 | 12.9 10.5 15.8 | 11.5 9.3 14.1 |

Abbreviations: 95% CI, 95% confidence interval; CRC, colorectal cancer.

aHigh school included passing the General Educational Development (high school equivalency) examination.

### TABLE 8. Colorectal and Prostate Cancer Screening by Race/Ethnicity Among Men Aged 50 Years and Older, National Health Interview Survey, 2015

|                     | TOTAL   | HISPANIC | NHW     | BLACK   | ASIANa  |
|---------------------|---------|----------|---------|---------|---------|
|                     | %       | 95% CI   | %       | 95% CI  | %       | 95% CI  |
| Prostate and CRC screen | 28.9    | 27.4 30.5 | 18.6    | 15.2    | 22.6    | 31.7    | 29.8    | 33.5    | 27.2    | 23.4    | 31.4    |
| CRC only            | 33.5    | 32.0 35.1 | 27.6    | 23.2    | 32.4    | 34.0    | 32.2    | 35.9    | 34.4    | 30.5    | 38.5    | 36.3    | 29.9    | 43.2    |
| Prostate only       | 6.7     | 6.0 7.6  | 7.5    | 5.2     | 10.6    | 7.0     | 6.0    | 8.1     | 4.7     | 3.1     | 7.1     | a       | a       | a       |
| None                | 30.8    | 29.3 32.4 | 46.3    | 41.7    | 51.1    | 27.4    | 25.6    | 29.2    | 33.7    | 29.8    | 37.9    | 45.4    | 37.0    | 54.0    |

Abbreviations: 95% CI, 95% confidence interval; CRC, colorectal cancer; NHW, non-Hispanic white.

aProstate-specific antigen testing in the past year, colonoscopy in the past 10 years, sigmoidoscopy in the past 5 years, and/or stool testing in the past year.

bThe estimate was unstable (relative standard error exceeds 30%).
TABLE 9. Colorectal and Prostate Cancer Screening by Education Among Men Aged 50 Years and Older, National Health Interview Survey, 2015a

|                     | TOTAL               | LESS THAN HIGH SCHOOL | HIGH SCHOOL | SOME COLLEGE | COLLEGE |
|---------------------|---------------------|-----------------------|-------------|--------------|---------|
|                     | % 95% CI            | % 95% CI              | % 95% CI    | % 95% CI     | % 95% CI |
| Prostate and CRC screen | 28.9  27.4  30.5 | 16.2  13.4  19.5 | 25.0  22.2  28.0 | 28.4  25.5  31.5 | 37.8  34.7  41.1 |
| CRC only            | 33.5  32.0  35.1 | 31.8  28.0  35.9 | 32.5  29.7  35.5 | 34.7  31.8  37.8 | 34.0  31.4  36.8 |
| Prostate only       | 6.7   6.0   7.6   | 6.6   4.7   9.2   | 6.3   4.9   8.2   | 6.5   5.1   8.2   | 7.4   6.0   9.2   |
| None                | 30.8  29.3  32.4 | 45.4  41.3  49.5 | 36.2  33.2  39.2 | 30.4  27.6  33.4 | 20.7  18.3  23.4 |

Abbreviations: 95% CI, 95% confidence interval; CRC, colorectal cancer.

aProstate-specific antigen testing in the past year, colonoscopy in the past 10 years, sigmoidoscopy in the past 5 years, and/or stool testing in the past year.

By education, 77.7% of women with less than a high school degree received at least one cancer screening test, compared with 95.2% of college graduates (Table 7). Receipt of all 3 screening tests ranged from 26.6% in those with less than a high school education to 50.7% in college graduates. Among men, rates of CRC screening only do not increase with increasing education as much as combined CRC screening and prostate cancer screening: 48% of men with less than a high school education report CRC and prostate cancer screening compared with 72.8% of college-educated men (Table 9).

Given the very low rate of lung cancer screening among eligible, high-risk adults, we also sought to determine the rate at which current or former smokers who met the USPSTF criteria for lung cancer screening were being screened for other cancers, suggesting a missed opportunity to refer these patients to lung cancer screening. Among high-risk current and former smokers who were eligible for LDCT, a small proportion of males and females received LDCT for lung cancer screening in the past year (see Table 5). However, among high-risk males, a substantial proportion had a PSA test and were up-to-date with CRC screening (23.8%) or had at least one other recent cancer screening (37.5%) had either a PSA in the past year or recent CRC screening). Among high-risk females, most current or former smokers had some combination of breast and/or CRC screening (70.2%). Although it has been shown that a high proportion of adults who responded to the NHIS and were eligible for lung cancer screening did not have health insurance or were Medicaid insured,140 the observation that a substantial proportion of high-risk current and former smokers who are eligible for LDCT screening undergo other screening tests but are not undergoing LDCT screening suggests a missed opportunity to assess risk and discuss screening for lung cancer.

Discussion
The most recent data on cancer screening rates are cause for concern, which we also noted in 2018.20 As described above, although CRC screening rates have steadily risen, screening rates for cervical cancer have declined since 2005, breast cancer screening rates have remained stable at a discouragingly low level, and uptake of lung cancer screening is hardly measurable. In a recent report in the Morbidity and Mortality Weekly Report, White and colleagues155 lamented that the use of recommended screening tests remains substantially below Healthy People 2020 targets for the nation and that disparities in the proportion of adults reporting recent cancer screening by race/ethnicity, socioeconomic status, and other health care access indicators continue to reveal that enduring inequality in access to screening is a factor in worse prognoses and outcomes in vulnerable groups. Of even greater concern is the low proportion of adults who report that they are current with all recommended screening tests. In the 2015 NHIS study, only 42% of women report that they have had recent breast, cervical, and CRC screening, and we know from evaluations of the accuracy of self-reports that national surveys overestimate the rate of recent cancer screening.156,157

Nearly 2 decades ago, Ruffin et al reviewed over 500 patient charts in a primary care system and demonstrated that completion of recommended tests, as documented in the patient record, was 8.6% for women aged 40 to 49 years and 3% for women aged 50 years and older.158 The strongest predictor of documented cancer screening was evidence in the chart of a health maintenance visit. In 2007, Fenton et al159 sought to determine the importance of the periodic health examination (PHE) in adherence with cancer screening in a large Washington State health plan. Slightly more than one-half of plan enrollees underwent a PHE during the study period. The investigators observed that receipt of PHE was strongly associated with the relative incidence of recent cancer screening compared with patients who had not had a PHE (ie, 3.47 for CRC screening, 3.06 for prostate cancer screening, and 1.23 for breast cancer screening). Although higher screening rates are observed in adults who have higher education, higher income, health insurance, a usual source of care, and receive a reminder
to undergo screening from a health care professional, there still is a higher probability (after taking these demographic and clinical factors into account) that screening will take place if the patient has undergone a checkup. Alternatives to the PHE can be productive, such as when electronic health records are mined to identify patients who are not current with recommended cancer screening or may have experienced a delay in diagnosis based on prior test results, such as an elevated PSA, a positive FOBT, or a positive mammogram, without follow-up.\textsuperscript{160,161} However, a recent study indicated that, even in the presence of population-based outreach strategies, patients who had one or more visit to a primary care provider had nearly twice the odds of having undergone recent CRC screening and a 30% greater likelihood of having had a follow-up colonoscopy after a positive FIT/FOBT.\textsuperscript{162} Those authors concluded that, in an era of increasing reliance on data systems and population health outreach systems, primary care visits have not lost their importance for engaging patients in cancer screening and follow-up care.

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