**ARTICLE TITLE:** Cancer Screening in the United States, 2017: A Review of Current American Cancer Society Guidelines and Current Issues in Cancer Screening

**CONTINUING MEDICAL EDUCATION ACCREDITATION AND DESIGNATION STATEMENT:**
Blackwell Futura Media Services is accredited by the Accreditation Council for Continuing Medical Education (CME) for physicians.
Blackwell Futura Media Services designates this enduring material for a maximum of 1.75 *AMA PRA Category 1 Credit™*. Physicians should only claim credit commensurate with the extent of their participation in the activity.

**CONTINUING NURSING EDUCATION ACCREDITATION AND DESIGNATION STATEMENT:**
The American Cancer Society (ACS) is accredited as a provider of continuing nursing education (CNE) by the American Nurses Credentialing Center’s Commission on Accreditation.
Accredited status does not imply endorsement by the ACS or the American Nurses Credentialing Center of any commercial products displayed or discussed in conjunction with an educational activity. The ACS gratefully acknowledges the sponsorship provided by Wiley for hosting these CNE activities.

**EDUCATIONAL OBJECTIVES:**
After reading the article “Cancer Screening in the United States, 2017: A Review of Current American Cancer Society Guidelines and Current Issues in Cancer Screening,” the learner should be able to:
1. Discuss American Cancer Society guidelines for the early detection of breast, colorectal, cervical, lung, and prostate cancers.
2. Provide patients with guidance and recommendations about appropriate early cancer detection options.
3. Relate about new and emerging cancer detection technologies.

**ACTIVITY DISCLOSURES:**
No commercial support has been accepted related to the development or publication of this activity.

**ACS CONTINUING PROFESSIONAL EDUCATION COMMITTEE DISCLOSURES:**
Editor: Ted Gansler, MD, MBA, MPH, has no financial relationships or interests to disclose.
Associate Editor: Durado Brooks, MD, MPH, has no financial relationships or interests to disclose.
Lead Nurse Planner: Kathy Meade, PhD, RN, FAAN, has no financial relationships or interests to disclose.
Editorial Advisory Member: Richard C. Wender, MD, has no financial relationships or interests to disclose.

**NURSING ADVISORY BOARD DISCLOSURES:**
Maureen Berg, RN, has no financial relationships or interests to disclose.
Susan Jackson, RN, MPH, has no financial relationships or interests to disclose.
Barbara Lesser, BSN, MSN, has no financial relationships or interests to disclose.

**AUTHOR DISCLOSURES:**
Robert A. Smith, PhD, reports that the American Cancer Society (ACS) has received a contribution from AstraZeneca Pharmaceuticals, LP, as the founding sponsor of a National Lung Cancer Roundtable to engage key organizations in reducing incidence, morbidity, and mortality from lung cancer through appropriate screening, smoking cessation, and management; he will receive partial salary support through this contribution for his efforts as Principal Investigator of the Roundtable.
Stacey Fedewa, MPH, reports that the ACS Intramural Research Department has received grants from Merck in the past year. Otis W. Brawley, MD, reports that the ACS Intramural Research Department has received grants from Merck in the past year. Kimberly Andrews, Durado Brooks, MD, MPH, Deana Manassaram-Baptiste, PhD, MPH, Debbie Saalow, PhD, and Richard Wender, MD, have no financial relationships or interests to disclose.
The peer reviewers disclose no conflicts of interest. Identities of the reviewers are not disclosed in line with the standard accepted practices of medical journal peer review.

**SCORING:**
A score of 70% or better is needed to pass a quiz containing 10 questions (7 correct answers), or 80% or better for 5 questions (4 correct answers).

**INSTRUCTIONS ON RECEIVING CME CREDIT:**
This activity is intended for physicians. For information concerning the applicability and acceptance of CME credit for this activity, please consult your professional licensing board.
This activity is designed to be completed within 1.75 hours; physicians should claim only those credits that reflect the time actually spent in the activity. To successfully earn credit, participants must complete the activity during the valid credit period, which is up to 2 years from the time of initial publication.

**INSTRUCTIONS ON RECEIVING CNE CREDIT:**
This activity is intended for nurses. For information concerning the applicability and acceptance of CNE credit for this activity, please consult your professional licensing board.
This activity is designed to be completed within 1.75 hours; nurses should claim only those credits that reflect the time actually spent in the activity. To successfully earn credit, participants must complete the activity during the valid credit period, which is up to 2 years from the time of initial publication.

**FOLLOW THESE STEPS TO EARN CREDIT:**
- Log on to acsjournals.com/ce.
- Read the target audience, educational objectives, and activity disclosures.
- Read the activity contents in print or online format.
- Reflect on the activity contents.
- Access the examination, and choose the best answer to each question.
- Complete the required evaluation component of the activity.
- Claim your certificate.

This activity will be available for CME/CNE credit for 1 year following its launch date. At that time, it will be reviewed and potentially updated and extended for an additional 12 months.

All CME/CNE quizzes are offered online FREE OF CHARGE. Please log in at acsjournals.com/ce. New users can register for a FREE account. Registration will allow you to track your past and ongoing activities. After successfully completing each quiz, you may instantly print a certificate, and your online record of completed courses will be updated automatically.
Cancer Screening in the United States, 2017: A Review of Current American Cancer Society Guidelines and Current Issues in Cancer Screening

Robert A. Smith, PhD1; Kimberly S. Andrews, BA2; Durado Brooks, MD, MPH3; Stacey A. Fedewa, PhD, MPH4; Deana Manassaram-Baptiste, PhD, MPH5; Debbie Saslow, PhD6; Otis W. Brawley, MD7; Richard C. Wender, MD8

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 authors summarize current American Cancer Society cancer screening guidelines, describe an update of their guideline for using human papillomavirus vaccination for cancer prevention, describe updates in US Preventive Services Task Force recommendations for breast and colorectal cancer screening, discuss interim findings from the UK Collaborative Trial on Ovarian Cancer Screening, and provide the latest data on utilization of cancer screening from the National Health Interview Survey. CA Cancer J Clin 2017;67:100-121. © 2017 American Cancer Society.

Keywords: American Cancer Society, diagnosis, mass screening, neoplasms, prevention and control

Practical Implications for Continuing Education

> As of 2016, American Cancer Society and US Preventive Services Task Force guidelines/recommendations for cancer screening are quite similar for cervical cancer, colorectal cancer, and breast cancer. Recommendations for cervical and colorectal cancer are mostly the same, and breast cancer screening guidelines mostly differ on the basis of the age at which to start screening (45 vs 50 years) and the screening interval (1 vs 2 years, based on age).

> The American Cancer Society now recommends a 2-dose human papillomavirus vaccine schedule for girls and boys who initiate the vaccination series at ages 9 through 14 years. The second dose should be administered 6 to 12 months after the first dose. Three doses remain recommended for those who initiate the vaccination series at ages 15 through 26 years and for immunocompromised persons.

> New coverage for lung cancer screening under the Patient Protection and Affordable Care Act and Medicare challenges health care providers to identify adults ages 55 through 77 years who are current or former smokers and are candidates for lung cancer screening based on pack-years of exposure and their general health status.

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 as well as guidance related to early cancer detection when a direct recommendation for screening cannot be made. This annual report also includes the most current data on cancer screening rates and a discussion of timely 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 a current guideline 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 shows the recent history of ACS guideline updates as well as those in progress.3-17 In this update, we describe the current ACS guidelines (Table 2); current issues shaping screening for breast, colorectal, and lung cancer; similarities and differences between ACS recommendations and those of other groups; the UK Collaborative Trial of Ovarian Cancer Screening; an update of our guideline for the use of human papillomavirus (HPV) vaccination for cancer prevention; and the most recent data on cancer screening from the National Health Interview Survey (NHIS).

### Screening for Breast Cancer

Among US women, 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 average and total years of life lost.18 In 2017, the ACS estimates that there will be 252,710 cases of invasive breast diagnosed in US women and 40,610 deaths.19 After a period of declining age-adjusted breast cancer incidence rates (1999-2004), there has been an average, delay-adjusted annual percentage increase of 0.3% from 2004 through 2013.18 Age-adjusted breast cancer mortality rates have declined 36% from 1989 through 2012,20 with an estimated 249,000 deaths averted in US women over this period. Unfortunately, these overall favorable statistics are not shared equally among all races and ethnic groups. Although declines in death rates are seen in all racial/ethnic groups except American Indians/Alaska Natives, the disparity continues to increase between black and white women. In 2012, death rates were 42% higher in black women compared with white women.20 The ACS guideline for breast cancer screening in average-risk women was updated in

### Table 1. History of Recent Updates to ACS Cancer Early Detection Guidelines, and Guidelines for Human Papillomavirus Vaccine Use

| CANCER SITE       | YEAR (REFERENCES)                                                                 |
|-------------------|------------------------------------------------------------------------------------|
| Breast cancer     | 2003: Complete update (Smith 2003<sup>3</sup>)                                     |
|                   | 2007: Guidelines for MRI use in high-risk women (Saslow 2007<sup>4</sup>)          |
|                   | 2015: Complete update (Oeffinger 2015<sup>5</sup>)                                 |
|                   | 2017: Update for women at increased and high risk expected                          |
| Cervical cancer   | 2002: Complete update (Saslow 2015<sup>6</sup>)                                    |
|                   | 2007: Guidelines for HPV vaccine use (Saslow 2007<sup>7</sup>)                     |
|                   | 2012: Complete update (Saslow 2012<sup>8</sup>)                                    |
|                   | 2015: Update related to follow-up of HPV-negative ASCUS (Smith 2015<sup>9</sup>)    |
|                   | 2016: Update related to HPV vaccination guideline (Saslow 2016<sup>10</sup>)        |
|                   | 2017: Update related to HPV vaccine guideline (current report)                      |
|                   | 2017-2018: Update expected                                                        |
| Colorectal cancer | 2001: Complete update (Smith 2001<sup>11</sup>)                                   |
|                   | 2003: Technology update (Levin 2003<sup>12</sup>)                                 |
|                   | 2006: Update for postpolypectomy and postcolorectal cancer ressection surveillance (Rex 2006,13 Winawer 2006<sup>14</sup>) |
|                   | 2008: Complete update (Levin 2008<sup>15</sup>)                                    |
|                   | 2017: Update expected                                                             |
| Endometrial cancer| 2001: Guidance for counseling, shared decision making, and high-risk women (Smith 2001<sup>11</sup>) |
| Prostate cancer   | 2001: Guidance for shared decision making related to testing for early detection and screening recommendations for higher risk men (Smith 2001<sup>11</sup>) |
|                   | 2010: Complete update (Wolf 2010<sup>16</sup>)                                     |
|                   | 2017-2018: Update expected                                                        |
| Lung cancer       | 2001: Guidance for shared decision making (Smith 2001<sup>11</sup>)               |
|                   | 2011: Interim guidance on lung cancer screening (American Cancer Society Lung Cancer Guidance Workgroup 2011, available upon request) |
|                   | 2013: Complete update (Wender 2013<sup>17</sup>)                                |

Abbreviations: ACS, American Cancer Society; ASCUS, atypical cells of undetermined significance; HPV, human papillomavirus; MRI, magnetic resonance imaging.
| CANCER SITE     | POPULATION                                      | TEST OR PROCEDURE                                      | RECOMMENDATION                                                                                                                                                                                                 |
|----------------|------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Breast         | Women, ages 40-54 y                              | Mammography                                            | Women should undergo regular screening mammography starting at age 45 y; women ages 45 to 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                                                        |
| Cervix         | Women, ages 21-29 y                              | Pap test                                               | Cervical cancer screening should begin at age 21 y; for women ages 21 to 29 y, screening should be done every 3 y with conventional or liquid-based Pap tests                                                                                                                   |
|                | Women, ages 30-65 y                              | Pap test and HPV DNA test                              | For women ages 30 to 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, ages 66+                                  | Pap test and HPV DNA test                              | Women ages 66+ 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          | Pap test and HPV DNA test                              | Women who have had a total hysterectomy should stop cervical cancer screening                                                                                                                                 |
| Colorectal     | Men and women, aged ≥50 y, for all tests listed   | Guaiac-based fecal occult blood test (gFOBT) with at least 50% test sensitivity for cancer, or fecal immunochemical test (FIT) with at least 50% test sensitivity for cancer, or Multitarget stool DNA test<sup>a</sup>, or Flexible sigmoidoscopy (FSIG)<sup>b</sup>, or Double-contrast barium enema<sup>b</sup>, or Colonoscopy | Annual: Testing stool sampled from regular bowel movements with adherence to manufacturer’s recommendation for collection techniques and number of samples is recommended; FOBT with the single stool sample collected on the clinician’s a fingertip during a digital rectal examination is not recommended; ”throw in the toilet bowl” FOBTs also are not recommended; compared with guaiac-based tests for the detection of occult blood, immunochemical tests are more patient friendly and are likely to be equal or better in sensitivity and specificity; there is no justification for repeating FOBT in response to an initial positive finding; patients should be referred to colonoscopy Every 3 y, per manufacturer’s recommendation Every 5 y, FSIG can be performed alone, or consideration can be given to combining FSIG performed every 5 y with a highly sensitive gFOBT or FIT performed annually Every 5 y Every 10 y Every 5 y                                                                                                                                 |
| 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 ages 55-74 y in good health with at least a 30 pack-y history | Low-dose helical CT                                     | Clinicians with access to high-volume, high-quality lung cancer screening and treatment centers should initiate a discussion about annual lung cancer screening with apparently healthy patients ages 55 to 74 y who have at least a 30 pack-y smoking history and who currently smoke or have quit within the past 15 y; a process of informed and shared decision making with a clinician related to the potential benefits, limitations, and harms associated with screening for lung cancer with low-dose CT should occur before any decision is made to initiate lung cancer screening; smoking-cessation counseling remains a high priority for clinical attention in discussions with current smokers, who should be informed of their continuing risk of lung cancer; screening should not be viewed as an alternative to smoking cessation                                                                 |
| Prostate       | Men, 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, Papanicolaou. *All individuals should become familiar with the potential benefits, limitations, and harms associated with cancer screening. <sup>a</sup> All positive tests must be followed up with colonoscopy.
The 2015 update was the first guideline incorporating the new process for ACS guideline development and was carried out by the ACS interdisciplinary Guideline Development Group (GDG). It was also the first guideline that incorporated recommendations graded as “strong” or “qualified” based on quality of evidence, the overall balance of benefits and harms, and consideration of patient preferences. The methodology and underlying rationale for the evidence that was considered in the guideline update are described in detail in the guideline report, the systematic evidence review, and last year’s annual review in this journal. However, it is worth highlighting the meaning of the grades applied to recommendations. 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 an intervention, in this case to be screened for breast cancer. A “qualified” recommendation indicates consensus that there is evidence of benefit but less certainty about either the balance of benefits and harms or patients’ values and preferences for the intervention. Both strong and qualified recommendations are an endorsement of the intervention. In the 2015 guideline update, average-risk women were defined broadly as those without a personal history of breast cancer, a confirmed or suspected genetic mutation on a breast cancer susceptibility gene known to increase risk of cancer, a confirmed or suspected genetic mutation on a defined broadly as those without a personal history of breast cancer. In the 2015 guideline update, average-risk women were recommended for biennial screening before age 50 years should be individual-based on the following reasons: women who place a higher value on the potential benefit than the potential harms may choose to begin biennial screening between the ages of 40 and 49. Finally, the USPSTF concluded that the evidence was insufficient to determine the balance of benefits and harms in women aged 75 years and older. Although the general recommendation was consistent with the last update of the USPSTF's recommendation in 2009, there were some important differences. In particular, the USPSTF noted that the benefits of mammography screening outweighed the harms in women ages 40 to 74 years but also stressed that the balance of benefits to harms was most favorable for women in their 60s and was less favorable for women in their 40s. The USPSTF also noted that, with respect to screening during the 40s, it was a “false dichotomy” to assume that women’s only options were to choose to begin screening at age 40 years or to delay beginning screening until age 50 years, stating that most of the benefit of screening in the 40s would be obtained by beginning screening at age 45 years. A comparison of the ACS and USPSTF recommendations reveals important similarities and differences. Each organization endorses a woman’s right to begin screening at age 40 years, although the USPSTF recommends biennial screening at all ages from 40 to 74 years; whereas the ACS endorses a hybrid model of annual screening from ages 40 to 54 years and biennial screening from ages 55 years onward, with the option to continue annual screening after age 54 years based on a woman’s choice. The USPSTF recommends screening to age 74 years but also acknowledges that modeling data support the potential for women aged 75 years and older who are in good health to benefit from continuing mammography screening. The ACS does not set a stopping age and instead recommends that older women in good health with an expected longevity of 10 years or greater continue screening. The differences between the ACS guideline and the USPSTF recommendations are evident in the methodology, interpretation of evidence, and judgment applied by the ACS GDG in their consideration of the burden of disease, evidence of benefit and harms, and judgment about the balance of benefit and harms.

**Burden of Disease**

Guideline groups have commonly differed in their recommendation to begin screening at age 40 versus 50 years, and the underpinnings of these decisions have been an enduring source of debate. Because the risk of disease is one among several factors related to the age to begin screening, the ACS GDG examined data on the burden of breast cancer by age in smaller age ranges (1-year and 5-year age groups) compared with the more common presentation of data in

---

CA: A Cancer Journal for Clinicians

---

104
10-year age groups (ie, ages 40-49 years, 50-59 years, etc) or by comparing women in their 40s with women ages 50 years and older. In their examination of risk in 5-year risk groups, it was apparent that the absolute 5-year risk among women ages 45 to 49 years (0.9%) and women ages 50 to 54 years (1.1%) was similar, as were the proportions of all incident breast cancer cases (10% and 12%, respectively) and incidence-based mortality (10% and 11%, respectively). In addition, the age-specific, incidence-based person-years of life lost, an indicator of premature mortality, also was similar for women ages 45 to 49 and 50 to 54 years (approximately 15% of the total person-years of life lost for all women was attributable to a diagnosis of breast cancer in each age group). This examination of the burden of disease within 5-year age groups indicates that traditional comparisons of women in their 40s either with women in their 50s or with women ages 50 years and older obscure similarities among women ages 45 to 49 years and 50 to 54 years. Given the size of these 2 age groups (>11 million women), the similar risk and contribution to the overall burden of disease, and the evidence of effectiveness of screening in each age group (see below), the GDG elected to recommend that all women begin screening at age 45 years, whereas women ages 40 to 44 years, who have lower risk, should have the option to begin annual screening earlier. Also noteworthy is the burden of disease in women ages 70 years and older. More than one-third of all breast cancer deaths are attributable to women diagnosed after age 70 years. Given that a majority of women between ages 70 and 80 years are in good health and can expect to live 10 years or longer, the data suggest important opportunities to avoid morbidity and mortality from breast cancer in older women. In applying clinical judgment about longevity, clinicians should use mortality indices that incorporate age, comorbidities, and functional status. In addition, older women should be provided opportunities for individualized decision making that considers potential benefits and harms and incorporates health priorities and patient preferences.

Benefits of Screening and the Screening Interval

The GDG regarded randomized controlled trial (RCT) results as providing good foundational evidence of the efficacy of screening, whereas the results of contemporary observational studies were informative in important ways about the effectiveness of modern mammography screening among women who actually attend screening. The observational studies also have advantages for measuring age-specific benefits of mammography screening, because they can measure the effects of screening based on age at exposure, whereas the RCTs measure outcomes based on age at randomization. The systematic review concluded that there is consistent evidence across all study designs that invitation or exposure to mammography screening, compared with usual care, is associated with reduced breast cancer mortality overall, as well as in age-specific subgroups. The magnitude of the observed mortality reductions ranged from 15% to 54%, depending on the study design and whether the mortality reduction was associated with invitation versus exposure to screening. As would be expected, both case-control studies and incidence-based mortality studies based on exposure to screening demonstrated the greatest mortality reductions overall and in age-specific subgroups, in large part because deaths from breast cancer in an unscreened group are compared only with those in women exposed to screening. Because no RCTs have compared outcomes based on annual versus biennial screening, recommended breast cancer screening intervals principally have been based on estimates of average tumor growth rates, ie, the mean tumor sojourn time, to ensure a greater chance that breast cancers will be detected by screening before symptoms develop. Evaluations of RCT data have estimated that sojourn times were shorter for women in their 40s (1.7 years) compared with women ages 50 to 59 years (3.3 years) and ages 60 to 69 years (3.8 years). and similar differences in sojourn times have been estimated for women ages 40 to 54 years versus 55 years and older. In an analysis of screening registry data commissioned for the guideline update, Miglioretti et al compared outcomes associated with annual (range, 11-14 months) versus biennial (range, 23-26 months) screening among 15,440 women diagnosed with breast cancer. Among premenopausal women, those who were screened biennially had statistically higher risks of being diagnosed with an advanced cancer; specifically, they had a 28% higher risk of being diagnosed with tumors that were stage IIB or higher, a 21% higher risk of being diagnosed with a tumor greater than 15 mm in size, and an 11% chance of being diagnosed with any less favorable prognostic tumor characteristic compared with women who underwent annual screening. Among postmenopausal women who were not taking menopausal hormone therapy, there was no clear advantage of annual screening compared with biennial screening.

Harms Associated With Screening

In addition to consideration of the burden of disease and the benefit of breast cancer screening in terms of mortality reduction, attention should be given to experiences described as harms, which include being recalled for an abnormality that is later determined to be a false-positive, undergoing biopsy that also is determined to be based on a false-positive finding, and the anxiety that may be associated with each; overdiagnosis; radiation exposure; etc. These differ quantitatively in terms of their frequency and qualitatively in terms of the degree and importance of adverse...
effects experienced by different women. For some women, being recalled for further imaging has little or no lasting adverse effects, whereas other women will experience greater and sometimes persistent adverse effects. In the US Breast Cancer Surveillance Consortium, age-specific mammography false-positive rates ranged from 12.1% for women ages 40 to 49 years to 7% for women ages 70 to 79 years, whereas false-positive biopsy rates (based on recommendation for biopsy) ranged from 1.64% for women ages 40 to 49 years to 1.7% for women ages 70 to 79 years. The GDG focused less on false-positive imaging outcomes and more on false-positive biopsies, which are less common, as a more important harm. It is also important to acknowledge that not all false-positive biopsies should be judged as unnecessary by virtue of their benign outcome. A more serious but difficult to measure harm is overdiagnosis, ie, the diagnosis of a nonprogressive breast cancer. The systematic review performed for the ACS judged that the likelihood of the existence of overdiagnosis was high but that there was insufficient evidence to reliably estimate a lifetime risk of overdiagnosis among women undergoing mammography screening. Higher estimates of overdiagnosis tended to be based on studies that did not adequately adjust for lead time or contemporaneous trends in incidence and had inadequate follow-up. When these methodological criteria are met, estimates of overdiagnosis of invasive disease tend to be very low, suggesting that overdiagnosis of invasive disease is uncommon.

**Screening Women at High Risk**

In 2007, the ACS issued a guideline for women who were known or likely carriers of a BRCA1 mutation and other rarer, high-risk genetic syndromes or who had been treated with radiation to the chest for Hodgkin disease. Annual screening mammography and magnetic resonance imaging (MRI) starting at age 30 years are recommended for women with a known BRCA1 mutation, women who are untested but have a first-degree relative with a BRCA1 mutation, or women with an approximately 20% to 25% or greater lifetime risk of breast cancer based upon specialized breast cancer risk-estimation models capable of pedigree analysis of first-degree and second-degree relatives on both the maternal and paternal sides. Annual MRI and mammography also are recommended for women who were treated for Hodgkin disease with radiation to the chest at a young age and women with Li-Fraumeni, Cowden, and Bannayan-Riley-Ruvalcaba syndromes and their first-degree relatives. At the time these recommendations were issued, there was judged to be insufficient evidence to recommend MRI for women at elevated risk because of other risk factors. At this time, the ACS is updating its guideline for women at higher and very high risk because of genetic syndromes and other risk factors, including breast density.

**Screening for Cervical Cancer**

The ACS estimates that 12,820 women will be diagnosed with invasive cervical cancer, and 4210 women will die from the disease in 2016. Cervical cancer incidence and mortality rates have declined since the introduction of the Papanicolaou (Pap) test in the mid-20th century, and rates continue to decline. For the period from 2003 through 2013, delay-adjusted cervical cancer incidence rates have decreased at an average annual percentage rate of −2.4% per year; and, over the same period, cervical cancer mortality rates have declined at an average annual rate of −0.8%. In 2012, the ACS, the American Society for Colposcopy and Cervical Pathology, and the American Society for Clinical Pathology issued a joint guideline for cervical cancer screening based on a systematic evidence review and using a collaborative process that included 25 organizations (Table 2). Similar recommendations were released in 2012 by the USPSTF and by the American College of Obstetricians and Gynecologists. The screening guideline recommends surveillance strategies and options based on a woman’s age, screening history, risk factors, and her choice of screening tests. Women younger than 21 years should not be screened regardless of their age of sexual initiation, and women at any age should not be screened annually by any screening method. Specifically:

- Screening for cervical cancer should begin at age 21 years. Women ages 21 to 29 years should receive cytology screening every 3 years with either conventional cervical cytology smears or liquid-based cytology. HPV testing should not be used for women in this age group, although it can be used as a reflex test for women diagnosed with atypical squamous cells of undetermined significance (ASC-US).
- For women ages 30 to 65 years, the preferred approach is cotesting every 5 years with cytology and HPV testing. It is also acceptable for women to continue to be screened every 3 years with cytology alone.
- 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. Consistent with the 2012 guideline, an HPV-negative ASC-US result should be regarded as negative for the purpose of discontinuing screening.
- The ACS recommends that women with an HPV-negative ASC-US result should return for screening in 3
versus 5 years, consistent with the American Society for Colposcopy and Cervical Pathology recommendation.\textsuperscript{9}  
- Recommended screening practices should not change on the basis of a woman’s HPV vaccination status.

In 2014, the US Food and Drug Administration (FDA) approved one HPV DNA test for primary cervical cancer screening, ie, as a stand-alone test without concomitant cytology testing. Interim clinical guidance has been developed for providers interested in primary HPV testing as a screening approach.\textsuperscript{38} The ACS continues to monitor emerging data and experience as well as the resolution of remaining questions about this screening strategy.

**Special Considerations**

These recommendations were developed 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. Women who have had their cervix removed should not be screened unless they have a history of cervical intraepithelial neoplasia 2 (CIN2) or a more severe diagnosis. 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 with a history of CIN2 or a more severe diagnosis should continue to follow routine screening recommendations for women ages 30 to 65 years for at least 20 years, even if screening extends beyond age 65 years. Age-specific incidence data available from the National Cancer Institute’s Surveillance, Epidemiology, and End Results program and from cross-sectional studies of small geographic areas or clinic populations are consistent with the following observations: 1) The prevalence of precursor dysplastic lesions is greater among younger women compared with older women; and 2) a significant proportion of premalignant lesions will regress, especially in younger women. Age 21 years was chosen as the age to begin screening, because cervical cancer is rare in women younger than 21 years, and testing adolescents leads to unnecessary evaluation and potentially to avoidable treatment of preinvasive cervical lesions that have a high probability of eventual regression within the long lead time period. Because treatment has been associated with reproductive problems, screening before age 21 years was judged to represent a net harm. Although annual screening is associated with slightly higher sensitivity, this improvement is gained at the high cost of many unnecessary evaluations and treatments.\textsuperscript{39} The rationale for screening women ages 21 to 29 years every 3 years was based on comparisons of outcomes associated with 1-year, 2-year, and 3-year screening.

As noted above, annual testing results in slightly greater benefit but a considerable excess of harms, whereas little difference in benefit was observed in 2-year versus 3-year screening intervals.\textsuperscript{8} For women ages 30 to 65 years, the same logic of Pap testing every 3 years holds. The guideline also endorses cotesting with the Pap test and an HPV test every 5 years, which is preferred over screening with the Pap test alone. Evidence shows that the combination of HPV testing and cytology results in increased detection of prevalent CIN3, and in subsequent rounds a decrease in CIN3 or greater and invasive cancer. The greater sensitivity of cotesting also results in the opportunity to extend the screening interval. After age 65 years, women with a history of adequate prior negative screening findings and no history of CIN2 or greater within the past 20 years can stop screening. Once screening is discontinued, it should not resume for any reason, even if a woman reports having a new sexual partner. Additional details for managing cervical cancer screening in women with abnormal findings or with different risk are detailed in the guideline.\textsuperscript{8}

**Vaccination Against HPV**

Vaccination with the quadrivalent or bivalent HPV vaccine could prevent an estimated 24,600 cases of cancer in the United States annually attributable to HPV types 16 and 18; vaccination with the 9-valent HPV vaccine, which includes 7 high risk HPV types, could prevent an additional 3800 cases; in sum, a total of 28,500 cases could be prevented with broad application of the 9-valent vaccine.\textsuperscript{40} The ACS reviewed and updated its guideline on HPV vaccination based on a methodologic and content review of the Advisory Committee on Immunization Practices (ACIP) HPV vaccination recommendations. A literature review was performed to supplement the evidence considered by the ACIP and to address new vaccine formulations and recommendations as well as new data on population outcomes since publication of the 2007 ACS guideline.\textsuperscript{7} The ACS recommends vaccination of all children at ages 11 to 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. Late vaccination for those not vaccinated at the recommended ages should be completed as soon as possible. Providers should inform unvaccinated men and women ages 22 to 26 years that vaccination may not be effective in lowering their cancer risk. It is important that all women, regardless of whether they have been vaccinated, get screened for cervical cancer and precancers according to current guideline recommendations.\textsuperscript{10} In October, 2016, after FDA approval of a new dosing schedule for HPV vaccination, the ACIP recommended a new 2-dose schedule for girls and boys who initiate the vaccination series at ages 9 through 14 years. Three doses
remain recommended for those who initiate the vaccination series at ages 15 through 26 years and for immunocompromised persons. The ACIP and ACS reviewed published and unpublished data from clinical trials in which boys and girls received 2 doses of HPV vaccine with an interval of at least 5 months. Immunogenicity of 2 doses in individuals ages 9 to 14 years was found to be at least as high as immunogenicity of 3 doses in females ages 16 to 26 years across 7 studies. Efficacy and cost-effectiveness data provide further support for a 2-dose schedule. The ACS endorses the ACIP updated recommendation as follows: 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 (0, 6-12-month schedule). The ACS partners with the Centers for Disease Control and Prevention 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. The HPV Vaccinate Adolescents Against Cancers Project focuses on expanding current cancer-prevention and early detection interventions in federally qualified health care centers 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 2017, the ACS estimates that 135,430 new cases of colorectal cancer (CRC) will be diagnosed in women and men, and 50,260 women and men will die from this disease. CRC incidence and mortality rates have been declining for the past 2 decades, largely attributable to the contribution of screening to prevention and early detection. Between 2004 and 2013, CRC incidence declined at an average annual rate of 3%, and CRC mortality declined at an average annual rate of 2.7% per year. The guideline for screening and surveillance for the early detection of adenomatous polyps and CRC in average-risk adults was last updated in 2008 in an evidence-based consensus process that included the ACS, the US Multi-Society Task Force (USMSTF) on Colorectal Cancer (representing the American College of Gastroenterology, American Gastroenterological Association, and American Society for Gastrointestinal Endoscopy), and the American College of Radiology (Table 2). Recommendations for adults at increased and high risk were last updated in 2001; and, in 2006, the ACS and the USMSTF issued a joint guideline update for postpolypectomy and post-CRC resection surveillance. Those guidelines have since been updated by the USMSTF. The ACS is updating its CRC screening guideline at this time, with a new guideline expected in 2017. Screening options may be chosen based on individual risk, personal preference, and access. Average-risk adults should begin CRC screening at age 50 years with one of the following options: 1) an annual, high-sensitivity guaiac fecal occult blood test (gFOBT) or fecal immunochemical test (FIT), following the manufacturer’s recommendations for specimen collection; 2) a stool DNA (sDNA) test every 3 years; 3) flexible sigmoidoscopy (FSIG) every 5 years; 4) colonoscopy every 10 years; 5) double-contrast barium enema every 5 years; or 6) computed tomography (CT) colonography every 5 years. 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. For similar reasons, the guideline recommends discontinuing the use of older, lower sensitivity versions of the guaiac test (such as Hemoccult II) in favor of newer, high-sensitivity gFOBT (such as Hemocult SENSA), FIT, or multitarget sDNA tests. Health professionals should provide guidance to adults about the benefits, limitations, and potential harms associated with screening for CRC, including information on test characteristics and requirements for successful testing. 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. In contrast, evidence from randomized clinical trials and modeling has shown 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 that of colonoscopy. In 2016, the USPSTF updated their 2008 recommendations for CRC screening, with recommendations more similar to those of the 2008 ACS, USMSTF, and American College of Radiology. In the 2016 update, the USPSTF recommended adults begin annual screening for CRC at age 50 years and continue to age 75 years. CRC screening for adults ages 76 to 85 years should be individualized, based on the patient’s overall health and prior screening history. The USPSTF noted that adults in this age group who had never been screened would be more likely to benefit, as would adults who were healthy enough to undergo treatment and did not have life-limiting comorbid conditions.
In the section on clinical conditions, the USPSTF listed recommended screening methods, including: 1) annual high-sensitivity gFOBT or FIT, 2) FIT-DNA every 1 or 3 years, 3) colonoscopy every 10 years, 4) CT colonography every 5 years, 5) FSIG every 5 years, and 6) FSIG every 10 years combined with annual FIT.

**Recommendations for High-Risk Adults**

The ACS and other organizations recommend more intensive surveillance for individuals at higher risk for CRC. Individuals at higher risk for CRC include: 1) individuals with a history of adenomatous polyps; 2) individuals with a personal history of curative-intent resection of CRC; 3) individuals with a family history of either CRC or colorectal adenomas diagnosed in a first-degree relative, with differing recommendations based on the relative’s age at diagnosis; 4) individuals at significantly higher risk because of a history of inflammatory bowel disease of significant duration; or 5) individuals at significantly higher risk because of a known or suspected presence of 1 of 2 hereditary syndromes, specifically, Lynch syndrome or familial adenomatous polyposis. For these individuals, increased surveillance generally means a specific recommendation for colonoscopy if available and may include more frequent examinations and examinations beginning at an earlier age. The USMSTF also has issued new recommendations for genetic evaluation and management of Lynch syndrome.

**Quality Issues in Screening With Colonoscopy**

Most CRC screening in the United States is done with colonoscopy, and all adults screened with other testing options who have a positive test result should undergo further evaluation with colonoscopy. In 2016, we described the challenges to assuring that all adults undergoing colonoscopy receive a high-quality test. Factors that are widely accepted as indicators of the quality of colonoscopy include adequacy of the bowel preparation to allow good visualization of the colon lumen and wall, the cecal intubation rate, and—arguably most important—the adenoma detection rate (ADR). The ADR is defined as the proportion of patients undergoing screening colonoscopy that had one or more adenomas detected. Presently, gastrointestinal organizations recommend a target composite ADR of \( \geq 25\% \) (for men, \( \geq 30\% \); for women, \( \geq 20\% \)). Meeting or exceeding the recommended ADR is important, because the large majority of interval CRCs are believed to arise from lesions missed at the time of the index (ie, most recent) colonoscopy, and several studies have demonstrated a strong correlation between the average ADR recorded for an individual endoscopist and the likelihood of interval cancers among the patients served by that endoscopist. These and other studies clearly delineate the impact of variations in colonoscopy performance on CRC detection and mortality and reinforce the need for fully implemented colonoscopy quality-assurance programs in all screening environments. A standardized colonoscopy reporting and data system has been published to assist continuous quality-improvement initiatives within and across practices that use colonoscopy. Similarly, primary care clinicians should ask their consulting endoscopists to provide information on colonoscopy quality to make sure that referrals are made to a service that is undertaking the delivery of high-quality examinations. Recommendations on the role that primary care practices can play in contributing to the quality of colonoscopy received by their patients are available.

**Quality Issues in Stool Testing**

For a stool-based screening program to achieve outcomes similar to those obtained in clinical trials or estimated by recent models, the program must adhere to several important quality elements. These include the use of a test with documented performance characteristics, appropriate collection of stool specimens, and colonoscopy follow-up for all positive tests. Several publications have documented significant differences in test performance (particularly cancer sensitivity) between guaiac tests and FITs and between brands of FITs that are marketed in the United States. Multiple studies of Hemoccult II and similar traditional guaiac tests have found low sensitivity for cancer (range, 25%-38%) for unrehydrated tests and even lower sensitivity for advanced neoplasia. In one large study, sensitivity using unrehydrated Hemoccult II was even lower for cancer (12.9%) and advanced neoplasia (10.7%). In contrast, studies using a highly sensitive guaiac test (Hemoccult II Sensa) demonstrate markedly higher cancer sensitivity rates (range, 64%-80%). This striking difference in performance led to the ACS in 2008 to state that, among guaiac tests, only high-sensitivity tests like Hemoccult II Sensa are recommended for use as a CRC screening test. FITs generally have improved sensitivity for cancer compared with guaiac-based tests. A meta-analysis of 19 studies of FIT performance with a single application in asymptomatic, average-risk individuals estimated a pooled sensitivity for cancer of 79% and specificity of 94%. However, an accurate assessment of individual FIT performance is complicated by the wide variety (>50) of available brands. In addition, studies have demonstrated substantial variation in cancer sensitivity between different FIT brands. This heterogeneity of FITs has not been addressed by the developers of guidelines, who have traditionally recommended FITs as a class of tests for CRC screening. Although the USPSTF’s 2016 updated CRC screening recommendation does not explicitly depart from this tradition (ie, the
recommendation statement continues to recommend FITs as a class), the variation in performance is acknowledged: “Among the FITs that are cleared by the US Food and Drug Administration and currently available for use in the United States, the OC FIT-CHEK family of FITs (Polymedco)—which include the OC-Light and the OC-Auto—have the best test performance characteristics (i.e., highest sensitivity and specificity).” Inappropriate specimen collection is a common barrier to achieving high-quality stool occult blood testing. Testing stool samples obtained through a DRE for the presence of occult blood is not an evidence-based approach for CRC screening. Manufacturers of stool occult blood tests (guaiac and immunochromical) must submit performance data on their tests to the FDA to receive approval to market their product in the United States. There are currently more than 50 guaiac and immunochromical tests approved for use in the United States, and none of the manufacturers of these tests have submitted data to the FDA on the performance of their test when analyzing stool specimens obtained by DRE, nor do any of these manufacturers recommend that their test be used to evaluate DRE-obtained stool specimens. Instead, manufacturer’s FDA applications describe the performance of their tests on specimens from spontaneously passed stools, and their instructions for each of these tests state that the specimen for analysis should be collected by “scraping the surface of the fecal sample with the sample probe” or using a brush or other device, and the sample should be obtained “from the collection paper or from a specimen caught in a clean cup,” or from toilet bowl water adjacent to the stool specimen. Wiping a small amount of stool (or, at times, only stool-stained mucus) off the lining of the rectal vault with a gloved finger is not the same as collecting a specimen from a bowel movement and does not comply with the manufacturer’s recommendations. The largest study to investigate this technique evaluated results from 2665 patients who collected: 1) multiple specimens from stools passed spontaneously passed at home, 2) single stool specimens collected by DRE, and 3) complete colonoscopy. The single-sample, DRE-obtained stool specimen using a guaiac-based test missed 19 of 21 cancers (95%) that were found at colonoscopy, whereas analyses of home-collected, multiple specimens from the same patients led to a 400% improvement in performance. Although that study has not been replicated using a FIT, there are no published data suggesting that this is an appropriate method for performing CRC screening with FIT. No CRC screening guideline from any organization endorses testing of DRE-obtained stools as acceptable. In fact, the 2008 ACS guideline explicitly states that testing specimens obtained at DRE is not an acceptable method of CRC screening. Unfortunately, FOBT screening in the United States is not always performed in the prescribed manner. Investigators from the National Cancer Institute and the Centers for Disease Control and Prevention surveyed more than 1200 primary care physicians across the United States regarding their practices around fecal testing and follow-up. Twenty-five percent of respondents who order FOBT for CRC screening use exclusively in-office FOBT, and an additional 53% use in-office testing in some cases. In this survey, fewer physicians reported in-office testing compared with results from a previous survey, and hopefully this practice has declined further since 2007. In the absence of data demonstrating suitable performance characteristics of Hemocult II, Sensa, or any FIT on DRE-obtained samples, clinicians should restrict their stool testing to specimens from spontaneously passed stools, as this most closely approximates the conditions under which these tests were evaluated and cleared for use in the United States. Spontaneously passed specimens can be obtained either at home or in bathroom facilities at the office or clinic. FIT or guaiac testing of stool specimens collected during DRE is not an acceptable screening test, and clinicians should never use this approach for CRC screening. Appropriate follow-up of abnormal stool test findings is another key component of high-quality testing. Stool tests serve as the first step of a 2-step screening process, wherein step 2 is 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, research findings indicate that colonoscopy follow-up of positive stool blood test results is highly variable. Research has documented failure to complete follow-up colonoscopy within 12 months of a positive stool occult blood test in more than one-half of patients in some settings. Better outcomes have been documented in organized screening programs. One study comparing completion rates among 4 health systems in the United States found that rates of colonoscopy follow-up at 12 months varied from a low of 58% to as high as 83%. Programmatic elements associated with higher completion rates included explicit organizational targets for time to colonoscopy after a positive stool blood test and performance monitoring with monthly reporting. Some studies also suggest that patient navigation may increase the rate of colonoscopy completion in this circumstance, although evidence is mixed on the outcomes of this intervention. In some instances, insurance coverage policies may contribute to failed follow-up. Although the Patient Protection and Affordable Care Act requires most health plans (including Medicare) to cover CRC screening.
Prostate cancer is an important health concern for men:

- Screening with the prostate-specific antigen (PSA) blood test alone or with both the PSA test and digital rectal examination (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 test 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 that 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 test or DRE require prostate biopsies to determine whether or not the abnormal findings are cancer; biopsies can be painful, may lead to complications like 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:
  - 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.
  - 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.

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 161,360 new cases and 26,730 deaths expected in 2017. Prostate cancer incidence and mortality rates have been declining in both black and white men since the early 1990s, but the average annual percentage change has been lower in black men compared with white men, and both annual age-adjusted incidence and mortality rates are still nearly twice as high in black men compared with white men. 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 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 (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) 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 providers 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 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 at average risk for prostate cancer. For men with PSA levels between 2.5 and 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, and abnormal DRE. 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.

The ACS recommends that women at average and increased risk should be informed at the onset of menopause about risks and symptoms (in particular, unexpected bleeding and spotting) of endometrial cancer 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) the substantial likelihood of being a mutation carrier (ie, a mutation is known to be present in the family), or 3) the absence of genetic testing results in families with suspected autosomal-dominant predisposition to colon cancer should consider beginning annual testing for early endometrial cancer detection at age 35 years. The evaluation of endometrial histology with the 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 potential benefits, harms, and limitations of testing for early endometrial cancer detection.

Screening for Lung Cancer

Lung cancer is the most common non-skin cancer affecting both men and women, accounting for an estimated 222,500 new cases in 2017. Lung cancer also is the leading cause of death from cancer in men and women, accounting an estimated 155,870 deaths in 2017, which is approximately 26% of all cancer deaths in the United States. From 2004 to 2013, age-adjusted lung cancer incidence rates declined at an average annual rate of 2.6%, and age-adjusted mortality rates declined at an average annual rate of 2.8% and 3.4% in white and black men, respectively. Among women, for whom recent declines in incidence and mortality rates lagged behind those observed for men, from 2004 to 2013, age-adjusted lung cancer incidence rates declined at an average annual rate of 1.3% for white women and 1.4% for black women, and age-adjusted mortality rates declined at an average annual rate of 1.4% and 1.9% in white and black women, respectively. On the basis of results from the National Lung Screening Trial (NLST) and a systematic evidence review, the ACS issued a new lung cancer screening guideline in 2013. The ACS lung cancer screening guideline emphasizes that clinicians with access to high-volume, high-quality lung cancer screening and treatment centers should ascertain the smoking status and smoking history of their patients ages 55 to 74 years (Table 4) and should initiate a discussion about lung cancer screening with those patients who have at least a 30 pack-year smoking history, currently smoke or have quit within the past 15 years, and are in relatively good health. Core elements of this discussion should include the benefits, uncertainties, and harms associated with screening for lung cancer.
cancer with low-dose CT (LDCT) (Table 5). Adults who choose to be screened should follow the NLST protocol of annual LDCT screening until they reach age 74 years. Chest x-ray should not be used for cancer screening. When possible, adults who choose to be screened should enter an organized screening program at an institution with expertise in LDCT screening that has access to a multidisciplinary team skilled in the evaluation, diagnosis, and treatment of abnormal lung lesions. If an organized, experienced screening program is not available but the patient strongly wishes to be screened, then they should be referred to a center that performs a reasonably high volume of lung CT scans, diagnostic tests, and lung cancer surgeries. If such a setting is not available and the patient is not willing or able to travel to such a setting, then the risk of harms associated with lung cancer screening may be substantially higher than the observed risks associated with screening in the NLST, and screening is not recommended. Referring physicians should help their patients identify appropriate settings with this expertise. Smoking-cessation counseling constitutes a high priority for clinical attention among patients who are currently smoking. Current smokers should be informed of their continuing risk of lung cancer and referred to smoking-cessation programs. Screening should not be viewed as an alternative to smoking cessation. Clinicians should not discuss LDCT lung cancer screening with patients who do not meet the recommended criteria (Table 4). If lung cancer screening is requested, then these patients should be informed that, at this time, there is too much uncertainty regarding the balance of benefits and harms for individuals at younger or older ages and/or with less lifetime exposure to tobacco smoke and/or with sufficiently severe lung damage to require oxygen (or other health-related NLST exclusion criteria), and thus screening is not recommended. Where risk seems to approximate or exceed the NLST eligibility criteria in one category but not another, clinicians will need to use their best judgment in deciding whether to engage the patient in a discussion about screening. The USPSTF’s “B” rating of their recommendation for lung cancer screening in 2014 led to coverage for lung cancer screening under the Affordable Care Act; and, in early 2015, the Center for Medicare and Medicaid

| TABLE 4. Eligibility Criteria for the National Lung Screening Trial |
| --- |
| **Age** | Ages 55-74 y, with no signs or symptoms of lung cancer |
| **Smoking history** | Active or former smoker with a 30 pack-y history (a pack-y is the equivalent of one pack of cigarettes per d per y; one pack per d for 30 y or 2 packs per d for 15 y would both be 30 pack-y) |
| **Active smoker** | If active smoker, should also be vigorously urged to enter a smoking cessation program |
| **Former smoker** | If former smoker, must have quit within 15 y |
| **General health exclusions** | Metallic implants or devices in the chest or back |
| | Requirement for home oxygen supplementation |
| | Prior history of lung cancer or other lung cancer symptoms |

| TABLE 5. Key Discussion Points for the Process of Shared Decision Making Related to Screening for Early Lung Cancer Detection With Low-Dose Helical Computed Tomography |
| --- |
| **Benefit:** Screening with LDCT has been shown to substantially reduce the risk of dying from lung cancer |
| **Limitations:** LDCT will not detect all lung cancers or all lung cancers early, and not all patients who have a lung cancer detected by LDCT will avoid death from lung cancer |
| **Harms:** There is a significant chance of a false-positive result, which will require additional periodic testing and, in some instances, an invasive procedure to determine whether or not an abnormality is lung cancer or some nonlung-related incidental finding; <1 in 1000 patients with a false-positive result experiences a major complication resulting from a diagnostic workup; death within 60 d of a diagnostic evaluation has been documented but is rare and most often occurs in patients with lung cancer |

Helping individuals clarify their personal values can facilitate effective decision making:

- **Individuals who value the opportunity to reduce their risk of dying from lung cancer and who are willing to accept the risks and costs associated with having an LDCT and the relatively high likelihood of the need for further tests, even tests that have the rare but real risk of complications and death, may opt to be screened with LDCT every y**

- **Individuals who place greater value on avoiding testing that carries a high risk of false-positive results and a small risk of complications and who understand and accept that they are at a much higher risk for death from lung cancer than from screening complications may opt not to be screened with LDCT**

Abbreviations: CT, computed tomography; LDCT, low-dose computed tomography.
Services (CMS) determined that the evidence was sufficient to “add a lung cancer screening counseling and shared decision-making visit, and for appropriate beneficiaries, annual screening for lung cancer with LDCT, as an additional preventive service benefit under the Medicare program,” contingent on meeting specific coverage criteria, which are extensive and intended to ensure that LDCT lung cancer screening achieves high quality at each of several critical steps. Coverage for Medicare beneficiaries is consistent with the ACS guideline and the USPSTF recommendation, with the exception that coverage extends to age 77 years. A beneficiary must receive a written order for LDCT during a lung cancer screening counseling and shared decision-making visit, which must be provided by a physician or qualified nonphysician practitioner. The counseling and shared decision-making visit must include the following elements, which also must be documented in the patient’s medical record: 1) determination of eligibility; 2) shared decision making using one or more decision aids that describe benefits and harms of screening, follow-up diagnostic testing, overdiagnosis, false-positive rate, and total radiation exposure; 3) the importance of annual screening, the impact of comorbidities, and the ability or willingness to undergo diagnostic tests and therapy; and 4) the importance of smoking cessation or maintaining smoking cessation if the patient already has quit. Current smokers should receive information about tobacco-cessation interventions. Patients who are appropriate candidates for LDCT lung cancer screening should receive a written order for lung cancer screening with LDCT. For subsequent screening examinations, the written order for LDCT lung cancer screening may be furnished during any appropriate visit with a physician or qualified nonphysician practitioner without repeating the shared decision-making process. Written orders must contain the following information: 1) date of birth; 2) actual pack-year smoking history (number of pack-years); 3) current smoking status and, for former smokers, the number of years since quitting smoking; 4) a statement that the beneficiary is asymptomatic (no signs or symptoms of lung cancer); and 5) National Provider Identifier of the ordering practitioner. Imaging facilities and radiologists also must meet criteria linked to reimbursement. Radiologist qualifications include: 1) board certification or board eligibility with the American Board of Radiology or equivalent organization, 2) documented training in diagnostic radiology and radiation safety, 3) involvement in the supervision and interpretation of at least 300 chest CT acquisitions in the past 3 years, and 4) documented participation in continuing medical education in accordance with current American College of Radiology standards. Radiology imaging facilities that provide LDCT lung cancer screening will need to: 1) meet dose and technical standards related to the LDCT examination; 2) use a standardized lung nodule identification, classification, and reporting system; 3) make smoking-cessation interventions available to current smokers; and 4) collect and submit data to a CMS-approved registry for each LDCT lung cancer screening performed. The CMS has specified minimum data elements that will be collected to measure adherence to quality-assurance standards and for program evaluation.

Testing for Early Ovarian Cancer Detection

Although the annual incidence of ovarian cancer is low compared with that of breast cancer and precursor lesions of the cervix, it is the most lethal of the gynecologic cancers. Approximately 22,440 women will be diagnosed with ovarian cancer in 2017, and 14,080 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 patients with localized ovarian cancer is greater than 90%, only 15% of all women 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. However, the performance of these tests for screening when used alone or in combination has been poor. The sensitivity and specificity of pelvic examination for the detection of asymptomatic ovarian cancer are poor and do not support physical examination as a screening method. CA 125 has limited sensitivity and specificity, as does TVU when used independently or in combination. In 2011, the Prostate Lung Colorectal and Ovarian (PLCO) RCT of ovarian cancer screening with CA 125 and TVU concluded that simultaneous screening with CA 125 and TVU, compared with usual care, did not reduce ovarian cancer mortality. Based largely on the PLCO results, the USPSTF recommended against screening for ovarian cancer (D recommendation), concluding that there was adequate evidence that annual screening with TVU and CA 125 does not reduce ovarian cancer mortality, and that, likewise, there was adequate evidence that screening for ovarian cancer can lead to important harms, mainly surgical interventions in women without ovarian cancer. A promising approach to ovarian cancer screening has been demonstrated by the UK Collaborative Trial of Ovarian Cancer Screening (UKTOCS), which currently is assessing the efficacy of a multimodal screening strategy (MMS) that includes annual CA 125 screening using a risk of ovarian cancer algorithm (ROCA) and TVU as a second-line test, ultrasound alone, and usual
care in an RCT involving 202,638 asymptomatic women ages 50 to 74 years who were recruited from 13 centers in the United Kingdom. The ROCa measures changes in CA 125 over time over a baseline measure rather than with a single cutoff point, as has traditionally been used and was used in the PLCO study, and has shown improved sensitivity for smaller tumors without measurably increasing the false-positive rate. In the UKCTOCS, women with normal ROCa scores were referred to annual repeat screening, whereas women with intermediate ROCa scores were triaged to repeat CA 125 concentration testing in 3 months, and women with elevated ROCa scores were triaged to repeat CA 125 concentration testing and TVU in 6 weeks. Women undergoing annual screening in the arm that used TVU as the primary ovarian cancer screening test were referred to annual repeat screening if their results were normal, repeat TVU in 3 months if findings were unsatisfactory, and a scan with a senior ultrasonographer within 6 weeks if their scan was interpreted as abnormal. Women with persistent abnormal results were referred for clinical evaluation. The analysis compared ovarian cancer mortality in the MMS arm versus no screening and in the TVU arm versus no screening at 14 years of overall follow-up. A secondary, prespecified analysis limited the comparison to the MMS versus usual care groups, excluding women who were diagnosed on the prevalent screening round, on the assumption that some of these cases would already be advanced and unlikely to benefit from screening. In the primary analysis, which included both prevalent and incident detected cases, the investigators observed nonsignificant mortality reductions over years 0 through 14 of 15% (95% confidence interval, −3 to 30; \( P = .10 \)) associated with MMS and 11% (95% confidence interval, −7 to 27; \( P = .21 \)) associated with TVU. However, in the analysis in which prevalent cases were censored, MMS was associated with a statistically significant 20% (\( P = .021 \)) mortality reduction and a 28% mortality reduction for cases diagnosed in years 7 through 14. The authors described these findings as “encouraging” but cautioned that further follow-up (about 4 years) was needed before policy decisions about the value of MMS ovarian cancer screening could be made. In 1994, a National Institutes of Health Consensus Panel concluded that women who had 2 or more first-degree relatives diagnosed with ovarian cancer should be offered counseling about their ovarian cancer risk by a gynecologic oncologist (or other specialist qualified to evaluate family history and discuss hereditary cancer risks), because these women have a 3% chance of being positive for an ovarian cancer hereditary syndrome. The panel further advised that women with a known hereditary ovarian cancer syndrome, such as breast-ovarian cancer syndrome or site-specific ovarian cancer syndrome associated with mutations on BRCA1 and BRCA2 or Lynch II syndrome, should receive annual rectovaginal pelvic examinations, CA 125 determinations, and TVU until childbearing is completed or at least until age 35 years, at which time prophylactic bilateral oophorectomy is recommended. Although women with these hereditary syndromes are estimated to represent only 0.05% of the female population, they have a 40% estimated lifetime risk of ovarian cancer. The National Comprehensive Cancer Network’s latest statement on genetic/familial high-risk assessment: breast and ovarian cancer states that, although there “may be circumstances where clinicians find screening helpful, data do not support routine ovarian screening.” With these caveats in mind, they note that TVU and CA 125 may be considered at the discretion of the physician starting at ages 30 to 35 years for women at high risk.

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

In this update, we provide 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. Table 6 displays cancer screening prevalence for colorectal, breast, and cervical cancer between 2005 and 2015 and the extent of absolute change, expressed as the percentage increase or decrease, between 2 time periods (2005-2015 and 2013-2015). Between 2005 and 2015, CRC screening increased by 19.5% because of increasing use of colonoscopy. In 2015, CT colonography use was uncommon, and the inclusion of this test did not alter overall CRC screening prevalence estimates. Cervical cancer screening declined by 3.8% between 2005 and 2015, and there has been little change in breast cancer screening since 2005. Prostate cancer screening rates were stable between 2005 and 2010 but declined by 18% between 2010 and 2013, and the proportion of men reporting a PSA test in the past year for routine reasons declined from 37.8% to 30.8% according to NHIS data. Additional 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 is a paucity of data on LDCT for lung cancer screening in community practice, although a study using 2010 NHIS data estimated that 1.8% of current higher risk smokers and 4.4% of high-risk former smokers (who quit in the past 15 years) had undergone LDCT for lung cancer screening in the past year. These data were collected before any organization had issued guidelines or recommendations for lung cancer screening. In Table 7, we display cancer screening prevalence by race and ethnicity and 2 socioeconomic indicators (having health insurance
and educational attainment) that are strongly associated with access to and use of preventive medical services. In 2013, CRC screening prevalence ranged from 49.4% in Asians and 49.9% in Hispanics to 65.4% in non-Hispanic whites and was over twice as high among insured (59.6%) adults ages 50 to 64 years compared with the uninsured (25.1%). The proportion of women receiving mammographic screening in the past year ranged from 45.7% in Hispanic women to 55.4% in non-Hispanic black women and was over 2.5 times greater among insured (52.5%) women ages 50 to 64 years compared with uninsured women (20.9%) of the same age. Cervical cancer screening rates ranged from 73.3% in Asian women to 84.8% in non-Hispanic white women and were about one-third higher in insured women (84.4%) compared with uninsured women (60.8%). It is important to note that, although the NHIS is nationally representative and a useful tool to measure progress toward cancer screening, there are several limitations to sample surveys, which include respondents’ recall bias and tendency to overestimate screening practices as well as nonresponse bias, which may be partially, but not fully, accounted for in the survey weighting procedures. Thus, in most instances, these data likely overestimate the rate of recent cancer screening. Additional information on cancer screening surveillance, including rates of screening by state and other sociodemographic factors, can be found in the periodically updated American Cancer Society’s Cancer Prevention and Early Detection Facts and Figures and Interactive Cancer Statistics Center.

### Discussion

In 2016, ACS and USPSTF guidelines/recommendations for cancer screening became more similar. The recommendations for cervical cancer screening have been roughly equivalent for some years, with each organization recommending the same starting age and, for the most part, the same screening strategies. The overall recommendation for screening and the screening strategies included in the USPSTF 2016 update of recommendations for CRC screening are roughly equivalent to current ACS recommendations for the use of guaiac-based and immunochemical-based FOBT, multitarget sDNA testing, colonoscopy, and CT colonography. Lung cancer screening recommendations issued by the ACS and USPSTF differ only in terms of the age to stop screening (74 vs 80 years, respectively). Although the greatest difference between the ACS and the USPSTF can be found in recommendations for breast cancer screening, as described above, each organization affirms the value of screening from age 40 years onward and endorses the principles that women should be able to choose to begin screening from age 40 years onward and that the age to stop screening should be individualized. The only major difference between ACS and USPSTF recommendations are the age to start screening, with the ACS recommending age 45 and the USPSTF recommending age 50, and the screening interval, with the ACS recommending a hybrid approach of annual screening until age 54 years and biennial screening afterward, and the USPSTF recommending only biennial screening. Considered across all of these cancer-screening

### Table 6: Prevalence (%) of Recent Cancer Screening Examinations Among US Adults: National Health Interview Survey, 2015

| SCREENING EXAMINATION | 2005a | SE | 2008a | SE | 2010a | SE | 2013a | SE | 2015 | SE | 2015-2005 | 2015-2013 |
|------------------------|-------|----|-------|----|-------|----|-------|----|------|----|-----------|-----------|
| Colorectal cancer (adults aged ≥50 y) | Endoscopyb | 46.8 | 0.6 | 53.2 | 0.6 | 56.4 | 0.6 | 55.9 | 0.5 | 60.3 | 0.6 | 13.5 | 4.4 |
| Stool-based testc | 12.1 | 0.4 | 10.0 | 0.4 | 8.8 | 0.3 | 7.8 | 0.3 | 7.2 | 0.3 | −4.9 | −0.6 |
| Stool-based test or endoscopyd | 43.1 | 0.6 | 50.2 | 0.6 | 59.1 | 0.6 | 58.6 | 0.5 | 62.6 | 0.6 | 19.5 | 4.0 |
| Breast cancer (women aged ≥40 y) | Mammogram within the preceding y | 51.2 | 0.6 | 53.0 | 0.7 | 50.8 | 0.7 | 51.3 | 0.7 | 50.2 | 0.7 | −1.0 | −1.1 |
| Mammogram within the preceding 2 y | 66.5 | 0.6 | 67.1 | 0.7 | 66.5 | 0.6 | 65.9 | 0.6 | 64.3 | 0.6 | −2.2 | −1.6 |
| Cervical cancer (women ages 21-64 y) | Pap teste | 85.4 | 0.4 | 84.6 | 0.5 | 83.1 | 0.5 | 80.9 | 0.5 | 81.6 | 0.5 | −3.8 | 0.7 |

Abbreviations: Pap, Papanicolaou; SE, standard error. *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 US Census. **Endoscopy included sigmoidoscopy within the preceding 5 years or colonoscopy within the preceding 10 years. ***Stool-based tests included fecal occult blood tests or fecal immunochemical tests using a home test kit performed within the preceding year. The 2015 estimates include fecal immunochromatographic tests, prior years do not. ****These were stool-based tests within the preceding year, or sigmoidoscopy within the preceding 5 years, or colonoscopy within the preceding 10 years. *****These were women 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 due to a difference in the age category presented. Source: National Health Interview Survey 2005, 2008, 2010, 2013, and 2015 (National Center for Health Statistics, Centers for Disease Control and Prevention, Atlanta, GA).
| SCREENING EXAMINATION | RACE AND ETHNICITY | HEALTH INSURANCE | EDUCATIONAL LEVEL |
|-----------------------|--------------------|------------------|------------------|
|                       | WHITE | BLACK | HISPANIC | ASIAN | YES | NO | SOME HIGH SCHOOL OR LESS | HIGH SCHOOL DIPLOMA OR GED | SOME COLLEGE/ASSOC. DEGREE | COLLEGE GRADUATE |
| Colorectal cancer (adults aged ≥50 y)  |        |        |         |       |     |    |                       |                        |                         |                      |
| Endoscopyc           | 63.3  | 59.3  | 47.6    | 44.8  | 66.8 | 77.2 | 56.8       | 54.6                   | 51.6                   | 64.3                 |
| Stool-based testd    | 6.9   | 8.0   | 7.3     | 9.2   | 6.2  | 8.2  | 5.6       | 7.1                    | 8.0                    | 7.2                 |
| Stool-based test or endoscopye | 65.4  | 61.8  | 49.9    | 48.4  | 59.6 | 25.1 | 50.8       | 52.1                   | 47.1                   | 71.3                |
| Breast cancer (women aged ≥40 y)  |        |        |         |       |     |    |                       |                        |                         |                      |
| Mammogram within the preceding y | 50.3  | 55.4  | 45.7    | 47.1  | 52.5 | 20.9 | 38.9       | 45.0                   | 51.2                   | 57.9                 |
| Mammogram within the preceding 2 y | 64.8  | 68.8  | 60.8    | 59.4  | 67.8 | 30.7 | 50.8       | 58.0                   | 65.9                   | 73.2                 |
| Cervical cancer (women ages 21-64 y) |        |        |         |       |     |    |                       |                        |                         |                      |
| Pap testf            | 83.3  | 84.8  | 77.5    | 73.3  | 84.4 | 60.8 | 70.1       | 75.4                   | 84.0                   | 88.8                |

Abbreviations: ASSOC, associate; GED, General Educational Development test; NHIS, National Health Interview Survey; Pap, Papanicolaou; SE, standard error. aEstimates for whites, blacks, and Asians are among non-Hispanics. bHealth insurance status was analyzed among adults aged ≤64 years. cEndoscopy included sigmoidoscopy within the preceding 5 years or colonoscopy within the preceding 10 years. dStool-based tests included fecal occult blood tests or fecal immunochemical tests using a home test kit performed within the preceding year. The 2015 data include fecal immunochemical tests, prior years do not. eThese were stool-based tests within the preceding year, or sigmoidoscopy within the preceding 5 years, or colonoscopy within the preceding 10 years. fThese were women with intact uteri who had a Pap test within the preceding 3 years. Estimates by education are among women ages 25 to 64 years. Source: National Health Interview Survey 2015 (National Center for Health Statistics, Centers for Disease Control and Prevention, Atlanta, GA).
recommendations, there is little justification for inertia in screening referrals by primary care providers based on presumed guideline differences. However, as is evident in Table 6, utilization remains suboptimal, with important consequences for achieving the potential reductions in cancer mortality and other patient-important outcomes. Apart from recent increases in CRC screening rates, breast and cervical cancer screening rates, which are overestimated by population-based surveys, hit an unacceptably low plateau some years ago.

It has been customary in the conclusion of this annual report to stress the greater potential of organized versus opportunistic screening and the value of systems in achieving higher rates of screening and higher quality screening, which would mean improved population outcomes. However, the current primary care practice environment and payment structure do not fully incentivize prevention and early detection; thus, in addition to the consequences of disparities in insurance coverage and access to care, too many adults with insurance and a regular source of care do not receive counseling and timely referrals for screening (and appropriate follow-up) according to either ACS or USPSTF recommendations. Furthermore, as demands grow for increasingly tailored and personalized approaches to prevention and early detection, adequate primary care resources, including both time and expertise, will not be available without a national commitment to reform practice and payment structures to enable competent risk assessment; tailored, informed, and shared decision making; and reminder and tracking systems to promote adherence to screening and avoid loss to follow-up. It cannot be overstressed that cancer is the leading cause of death in men and women before age 85 years and the leading cause of premature mortality. We have the knowledge to significantly reduce this burden, but we must be realistic that greater progress will not be achieved without incentives to implement systems for prevention and early detection and the national expectation that they will used to make greater progress in reducing the human costs of cancer.

Author Contributions: Robert A. Smith: Conceptualization, supervision, investigation, writing—original draft, and writing—review and editing. Kimberly S. Andrews: Conceptualization, writing—original draft, and writing—review and editing. Durardo Brooks: Conceptualization, writing—original draft, and writing—review and editing. Stacey A. Fedewa: Conceptualization, formal analysis, writing—original draft, and writing—review and editing. Deana Manassaram-Baptiste: Conceptualization, writing—original draft, and writing—review and editing. Debbie Saslow: Conceptualization, writing—original draft, writing—review and editing. Otis W. Brawley: writing—review and editing. Richard C. Wender: writing—review and editing.

References

1. Brawley O, Byers T, Chen A, et al. New American Cancer Society process for creating trustworthy cancer screening guidelines. JAMA. 2011;306:2495-2499.
2. Smith RA, Kokkines V, Brawley OW. Cancer screening in the United States, 2012: a review of current American Cancer Society guidelines and current issues in cancer screening. CA Cancer J Clin. 2012;62:129-142.
3. Smith RA, Saslow D, Sawyer KA, et al. American Cancer Society guidelines for breast cancer screening; update 2003. CA Cancer J Clin. 2003;53:141-169.
4. Saslow D, Boetes C, Burke W, et al. American Cancer Society guidelines for breast screening with MRI as an adjunct to mammography. CA Cancer J Clin. 2007;57:75-89.
5. Oeffinger KC, Fontham ET, Etzioni R, et al. Breast cancer screening for women at average risk: 2015 guideline update from the American Cancer Society. JAMA. 2015;314:1599-1614.
6. Saslow D, Runowicz CD, Solomon D, et al. American Cancer Society guideline for the early detection of cervical neoplasia and cancer. CA Cancer J Clin. 2002;52:342-362.
7. Saslow D, Castle PE, Cox JT, et al. American Cancer Society Guideline for human papillomavirus (HPV) vaccine use to prevent cervical cancer and its Precursors. CA Cancer J Clin. 2007;57:7-28.
8. Saslow D, Solomon D, Lawson HW, et al. American Cancer Society, American Society for Colposcopy and Cervical Pathology, and American Society for Clinical Pathology screening guidelines for the prevention and early detection of cervical cancer. CA Cancer J Clin. 2012;62:147-172.
9. Smith RA, Manassaram-Baptiste D, Brooks D, et al. Cancer screening in the United States, 2015: a review of current American Cancer Society guidelines and current issues in cancer screening. CA Cancer J Clin. 2015;65:30-54.
10. Saslow D, Andrews KS, Manassaram-Baptiste D, et al. Human papillomavirus vaccination guideline update: American Cancer Society guideline endorsement. CA Cancer J Clin. 2016;66:375-385.
11. Smith RA, von Eschenbach AC, Wender R, et al. American Cancer Society guidelines for the early detection of cancer: update of early detection guidelines for prostate, colorectal, and endometrial cancers. Also: update 2001—testing for early lung cancer detection. CA Cancer J Clin. 2001;51:38-75; quiz 77-80.
12. Levin B, Brooks D, Smith RA, Stone A. Emerging technologies in screening for colorectal cancer: CT colonography, immunohistochemical fecal occult blood tests, and stool screening using molecular markers. CA Cancer J Clin. 2003;53:44-55.
13. Rex DK, Kahi CJ, Levin B, et al. Guidelines for colonoscopy surveillance after cancer resection. A consensus update by the American Cancer Society and US Multi-Society Task Force on Colorectal Cancer. CA Cancer J Clin. 2006;56:160-167; quiz 185-186.
14. Winawer SJ, Zauber AG, Fletcher RH, et al. Guidelines for colonoscopy surveillance after polypectomy: a consensus update by the US Multi-Society Task Force on Colorectal Cancer and the American Cancer Society. CA Cancer J Clin. 2006;56:143-159; quiz 184-185.
15. Levin B, Lieberman DA, McFarland B, et al. Screening and surveillance for the early detection of colorectal cancer and adenomatous polyps, 2008: a joint guideline from the American Cancer Society, the US Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology. CA Cancer J Clin. 2008;58:130-160.
16. Wolf AM, Wender RC, Etzioni RB, et al. American Cancer Society guideline for the early detection of prostate cancer: update 2010. CA Cancer J Clin. 2010;60:70-98.
17. Wender R, Fontham ET, Barrera E Jr, et al. American Cancer Society lung cancer screening guidelines. CA Cancer J Clin. 2013;63:107-117.
18. Howlader N, Noone AM, Krapcho M, et al. SEER Cancer Statistics Review, 1975–2016. Bethesda, MD: National Cancer Institute; 2016.
19. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2017. CA Cancer J Clin. 2017;67:7-30.
20. DeSantis CE, Fedewa SA, Goding Sauer A, Kramer JL, Smith RA, Jemal A. Breast cancer statistics, 2015: convergence of incidence rates between black and white women. CA Cancer J Clin. 2016;66:31-42.
21. Myers ER, Moorman P, Gierisch JM, et al. Benefits and harms of breast cancer screening: a systematic review. JAMA. 2015;314:1615-1634.
22. Smith RA, Andrews K, Brooks D, et al. Cancer screening in the United States,
2016: a review of current American Cancer Society guidelines and current issues in cancer screening. CA Cancer J Clin. 2016;66:96-114.

3. Andrews J, Guyatt G, Oxman AD, et al. GRADE guidelines: 14. Going from evidence to recommendations: the significance and presentation of recommendations. J Clin Epidemiol. 2013;66:719-725.

4. Andrews JC, Schunemann HJ, Oxman AD, et al. GRADE guidelines: 15. Going from evidence to recommendation—determinants of a recommendation’s direction and strength. J Clin Epidemiol. 2013;66:726-735.

5. Siu AL. US Preventive Services Task Force. Screening for breast cancer: US Preventive Services Task Force recommendation statement. Ann Intern Med. 2016;164:279-296.

6. US Preventive Services Task Force. Screening for breast cancer: US Preventive Services Task Force recommendation statement. Ann Intern Med. 2009;151:716-726, W-236.

7. Yourman LC, Lee SJ, Schonberg MA, Widera EW, Smith AK. Prognostic indices for older adults: a systematic review. JAMA. 2012;307:182-192.

8. Lee SJ, Smith A, Widera E, Yourman L, Schonberg M, Ahalit C. Prognosis—estimating prognosis for elders. pogoe.org/product/21148. Accessed December 12, 2016.

9. Walter LC, Schonberg MA. Screening for cervical cancer: estimates of overdiagnosis from two trials of mammographic screening for breast cancer in Europe: a literature review. J Med Screen. 2016;23:7-15.

10. Overdiagnosis in mammographic screening for breast cancer: a decision analysis of the US Preventive Services Task Force [Internet]. Report No. 11-05157-EF-1. US Preventive Services Task Force Evidence Syntheses, formerly Systematic Evidence Reviews. Rockville, MD: Agency for Healthcare Research and Quality; 2011.

11. Viens LJ, Henley SJ, Watson M, et al. Human papillomavirus-associated cancers—United States, 2008-2012. MMWR Morb Mortal Wkly Rep. 2016;65:661-666.

12. Meites E, Kempe A, Markowitz LE. Use of a 2-dose regimen of human papillomavirus—vaccination—updated recommendations of the Advisory Committee on Immunization Practices. MMWR Morb Mortal Wkly Rep. 2016;65:1405-1408.

13. Romanowski B, Schwarz TF, Ferguson L, et al. Sustained immunogenicity of the HPV-16/18 AS04-adjuvanted vaccine administered as a two-dose schedule in adolescent girls: five-year clinical data and modeling predictions from a randomized study. Hum Vaccin Immunother. 2016;12:20-29.

14. Puthakatik T, Huang LM, Chiu CH, et al. Randomized open trial comparing 2-dose regimen of the human papillomavirus 16/18 AS04-adjuvanted vaccine in girls aged 9-14 years versus a 3-dose regimen in women aged 15-25 years. J Infect Dis. 2016;214:525-536.

15. Lazzano-Ponce E, Stanley M, Munoz N, et al. Overcoming barriers to HPV vaccination: non-inferiority of antibody response to human papillomavirus 16/18 vaccine in adolescents vaccinated with a two-dose vs a three-dose regimen at 21 months. Vaccine. 2014;32:725-732.

16. Boxus M, Lockman L, Fochsato M, Lorin C, Thomas F, Giannini SL. Antibody avidity measurements in recipients of Cervarix vaccine following a two-dose schedule or a three-dose schedule. Vaccine. 2014;32:3232-3236.

17. Hernandez-Avila M, Torres-Ibarra L, Stanley M, et al. Evaluation of the immunogenicity of the quadrivalent HPV vaccine using 2- versus 3-doses at month 21: an epidemiological surveillance median for alternate vaccination schemes. Hum Vaccin Immunother. 2016;12:30-38.

18. Dobson SR, McNeil S, Dionne M, et al. Immunogenicity of 2 doses of HPV vaccine in younger adolescents vs 3 doses in young women: a randomized clinical trial. JAMA. 2013;309:1793-1802.

19. Iversen OE, Miranda MJ, Ulied A, et al. Immunogenicity and HPV infection after one, two, and three doses of quadrivalent HPV vaccine in girls in India: a multicentre prospective cohort study. Lancet Oncol. 2016;17:67-77.

20. Kreimer AR, Rodriguez AC, Hildesheim A, et al. Proof-of-principle evaluation of the efficacy of fewer than three doses of a bivalent HPV16/18 vaccine. J Natl Cancer Inst. 2011;103:1444-1451.

21. Kreimer AR, Struyf F, D’Souza Rosario Raymundo MR, et al. Efficacy of fewer than three doses of an HPV-16/18 AS04-adjuvanted vaccine: combined analysis of data from the Costa Rica Vaccine and PATRICIA Trials. Lancet Oncol. 2015;16:775-786.

22. Laprise JF, Markowitz LE, Chesson HW, Drolet M, Brissin M. Comparison of 2- dose and 3-dose 9-valent human papillomavirus vaccine schedules in the United States: a cost-effectiveness analysis. J Infect Dis. 2016;214:685-688.

23. The National HPV Vaccination Roundtable. The National HPV Vaccination Roundtable Sharepoint Site. msociety-source.org/sites/Roundtable/HPV-MMWR-Pages/Home-New.aspx. Accessed December 11, 2016.

24. American Cancer Society. The National HPV Vaccination Roundtable. cancer.org/healthy/informationforhealthcareprofessionals/nationalhpvvaccinationroundtable/index. Accessed December 11, 2016.

25. Siegel R, Desantis C, Jemal A. Colorectal cancer statistics, 2014. CA Cancer J Clin. 2014;64:104-117.

26. Lieberman DA, Rex DK, Winawer SJ, Giardiello FM, Johnson DA, Levin TR. Guidelines for colorectal cancer screening and surveillance after screening and polypectomy: a consensus update by the US Multi-Society Task Force on Colorectal Cancer. Gastroenterology. 2012;143:94-110.

27. Collins JF, Lieberman DA, Durbin TE, Weiss DG. Accuracy of screening for fecal occult blood on a single stool sample obtained by digital rectal examination: a comparison with recommended sampling protocols. Ann Intern Med. 2005;142:516-525.

28. Zauber AG, Lansdorp-Vogelaar I, Knudsen AB, Wilschut J, van Ballegooijen M, Kuntz KM. Evaluating test strategies for colorectal cancer screening: a decision analysis for the US Preventive Services Task Force. Ann Intern Med. 2008;149:659-669.

29. Shaukat A, Mongin SJ, Geisser MS, et al. Long-term mortality after screening for colorectal cancer. N Engl J Med. 2013;369:1106-1114.

30. Knudsen AB, Zauber AG, Rutter CM, et al. Estimation of benefits, burden, and harms of colorectal cancer screening strategies: modeling study for the US Preventive Services Task Force. JAMA. 2016;315:2535-2549.

31. US Preventive Services Task Force. Screening for colorectal cancer: US Preventive Services Task Force recommendation statement. Ann Intern Med. 2008;149:627-637.

32. Bibbins-Domingo K, Grossman DC, Curry SJ, et al. Screening for colorectal cancer: US Preventive Services Task Force recommendation statement. JAMA. 2016;315:2564-2575.

33. Winawer S, Fletcher R, Rex D, et al. Colorectal cancer screening and surveillance: clinical guidelines and rationale—update
107. National Center for Health Statistics. National Health Interview Survey. cdc.gov/nchs/nhis/about_nhis.htm. Accessed December 12, 2016.

108. Jemal A, Fedewa SA, Ma J, et al. Prostate cancer incidence and PSA testing patterns in relation to USPSTF screening recommendations. JAMA. 2015;314:2054-2061.

109. Han PK, Kobrin S, Breen N, et al. National evidence on the use of shared decision making in prostate-specific antigen screening. Ann Fam Med. 2013;11:306-314.

110. Hoffman RM, Couper MP, Zikmund-Fisher BJ, et al. Prostate cancer screening decisions: results from the National Survey of Medical Decisions (DECISIONS study). Arch Intern Med. 2009;169:1611-1618.

111. Doria-Rose VP, White MC, Klabunde CN, et al. Use of lung cancer screening tests in the United States: results from the 2010 National Health Interview Survey. Cancer Epidemiol Biomarkers Prev. 2012;21:1049-1059.

112. Rauscher GH, Johnson TP, Cho YI, Walk JA. Accuracy of self-reported cancer-screening histories: a meta-analysis. Cancer Epidemiol Biomarkers Prev. 2008;17:748-757.

113. American Cancer Society. Interactive Cancer Statistics Center. cancer.org/research/cancer-factsstatistics/index. Accessed December 1, 2016.