Cancer Screening in the United States, 2011
A Review of Current American Cancer Society Guidelines and Issues in Cancer Screening

Robert A. Smith, PhD1; Vilma Cokkinides, PhD2; Durado Brooks, MD, MPH3; Debbie Saslow, PhD4; Mona Shah, MPH5; Otis W. Brawley, MD6

Abstract
Each year the American Cancer Society (ACS) publishes a summary of its recommendations for early cancer detection, a report on data and trends in cancer screening rates, and select issues related to cancer screening. This article summarizes the current ACS guidelines, describes the anticipated impact of new health care reform legislation on cancer screening, and discusses recent public debates over the comparative effectiveness of different colorectal cancer screening tests. The latest data on the utilization of cancer screening from the National Health Interview Survey is described, as well as several recent reports on the role of health care professionals in adult utilization of cancer screening. CA Cancer J Clin 2011;61:8–30. © 2011 American Cancer Society.

Introduction
In 2010, the American Cancer Society (ACS) marked the 30th anniversary of the publication of the organization’s first formal effort to apply evidence-based methodology to the development of cancer screening guidelines.1 The process was led by Dr. David Eddy, an early pioneer in systematic evidence reviews, and addressed the supporting evidence and recommendations for screening for breast, cervical, and colorectal cancers. The evidence for lung cancer screening also was evaluated, but unfavorable results from the trials of chest x-ray screening did not support a recommendation that asymptomatic, at-risk adults undergo testing, a decision that still stands today.2 At that time there was no screening test for prostate cancer, and it would be later in the decade, after US Food and Drug Administration (FDA) approval for the use of the prostate-specific antigen (PSA) assay to follow prostate cancer patients for disease recurrence,3 before asymptomatic men would begin testing for early prostate cancer detection. Thirty years later, there still is uncertainty over the balance of benefits and harms associated with testing for early prostate cancer detection, and thus informed decision-making is endorsed rather than routine screening.4

During this 30-year period, there have been numerous updates in the cancer screening recommendations by the ACS and other organizations. The changes have been the result of new evidence supporting a change in a guideline, or discounting the value of a previous recommendation, and the guidelines process has evolved to consider new factors in the process of cancer screening, such as the importance of estimating both benefits and harms, and emphasizing the importance of informed and shared decision-making.5 Although recommendations commonly do not achieve complete consensus in terms of the protocol or age groups to invite to screening, by
and large there has been an increasing commitment among groups that issue guidelines that asymptomatic adults should undergo regular screening for breast, cervical, and colorectal cancer (CRC), and there also is agreement that screening has contributed to declines in mortality rates from these cancers over time.

In this yearly report, we will provide a summary of the current ACS cancer screening guidelines, a summary of guidance to the public related to early detection tests that are increasingly used by the public but not yet recommended due to the lack of consensus on their value for cancer screening, and the most recent data on adult cancer screening rates and trends, as well as several recent reports on the role of health care professionals in adult utilization of cancer screening. We will also describe recent studies that have called into question the added benefit of optical colonoscopy over flexible sigmoidoscopy (FSIG), provide an update on experimental data on screening for prostate cancer and research on ovarian cancer screening, and describe the changes in the Patient Protection and Affordable Care Act that will influence access to cancer screening tests for a significant fraction of the US adult population.

In order for guidelines to reflect the most current scientific evidence, the medical and scientific literature are monitored on an ongoing basis, and generally guidelines are reviewed and updated at least every 5 years, or sooner if new evidence warrants an immediate update in recommendations. The annual guideline reviews, as well as the more detailed cancer screening guideline updates, are published as stand-alone articles and are available online at http://caonline.amcancersoc.org. Table 1 shows the recent history of guidelines updates, as well as those currently in progress.4,6–15

Screening for Breast Cancer

Breast cancer is the most common cancer diagnosed in US women, and the second leading cause of death from cancer in US women.16 ACS guidelines for breast cancer screening in average-risk women were last updated in 2003,6 and screening guidelines for women at very high risk were last updated in 2007.7 Guidelines for women at very high risk recommend a combination of mammography and magnetic resonance imaging (MRI) and are appropriate for women with known or suspected inherited susceptibility to breast cancer, or women who have undergone mantle radiation to the chest at an early age for Hodgkin lymphoma (Table 2).7 Guidelines for the early detection of breast cancer in average-risk women consist of a combination of regular clinical breast examination (CBE) and counseling to raise awareness of breast symptoms beginning at age 20 years, and annual mammography beginning at age 40 years (Table 2).

Between the ages of 20 and 39 years, women should undergo CBE every 3 years, and annually after age 40 years. This examination should take place during periodic health examinations. When CBE is performed, it is an opportunity for health care professionals to review and update the woman’s family history; discuss the importance of early breast cancer detection; and answer any questions she may have about her own risk, new technologies, or other matters related to breast disease. During these discussions, health care professionals should emphasize the importance of awareness and recognition of breast changes, and if changes are perceived, the importance of contacting their physician promptly. They should also emphasize the importance of awareness of a family history of breast and ovarian cancers in first-degree and second-degree relatives on both the maternal and paternal side of the family. An opportunity to update the family history should take place during encounters for other preventive care or screening. Approximately 8.4% of all women report a family history of breast cancer in first-degree relatives, and approximately 2.7% of women between the ages of 20 and 29 years report a family history of breast cancer in first-degree relatives, which may include relevant family members diagnosed at a very young age.17 Thus, it is important to be attentive to family history even in young female patients, because some younger women will be candidates for beginning breast cancer screening before age 40 years.

Data from the 2005 Cancer Control Module of National Health Interview Survey (NHIS) indicate that approximately 1.4 million US women (<1%) have a family history of breast cancer that is sufficient to warrant a referral for genetic counseling and evaluation for genetic testing,18,19 but fewer than 2% of respondents who would be candidates for genetic counseling reported having been tested for high-risk mutations. Although there are numerous reasons
why women would reject counseling and testing, a major contribution to the low rate of testing likely is suboptimal attention to family history in the primary care setting. Research on the degree to which family history data are gathered, gathered completely, and then used indicates that this simple, initial step in risk assessment generally is not done competently, or is not done at all.23

Although the ACS no longer recommends monthly breast self-examination (BSE), women should be informed about the potential benefits, limitations, and harms (principally the possibility of a false-positive result) associated with BSE. Women may then choose to do BSE regularly, occasionally, or not at all. If a woman chooses to perform periodic BSE, she should receive instructions in the technique and periodically have her technique reviewed. Although the elimination of the direct recommendation for monthly BSE has seemed counterintuitive, there is little direct evidence concerning how increased breast self-awareness is achieved.

Breast awareness is, of course, a broad concept that includes both a woman’s understanding the implications of breast changes as well as having a heightened sense of personal awareness that leads to an earlier recognition of breast changes. It appears each is a factor in reducing delay in the diagnosis of symptomatic breast cancer. Rauscher et al evaluated factors associated with delay (>90 days) in reporting breast symptoms to a health care professional among 436 symptomatic patients. In addition to income, education, race/ethnicity, and access to care, misconceptions about breast lumps also were associated with delay in diagnosis.25 These included the belief that a lump only needed to be checked if it was painful or was growing, and the belief that pressing on the lump would cause it to become cancerous. With respect to these misconceptions, the authors observed a significant difference in delay in reporting symptoms among women who held one or more misconceptions about breast lumps. They also observed that women who had undergone a mammogram or CBE within the past 2 years were significantly less likely to delay reporting new breast symptoms. This observation is consistent with findings from the Swedish Two-County Trial of breast cancer screening, in which the investigators reported that women in the group invited to screening who were diagnosed with an interval cancer had more favorable tumor characteristics and lower mortality compared with the control group.26 These findings suggest that mammography screening itself contributes to increased awareness and may contribute more to increased awareness than direct educational programs about symptom detection.

### TABLE 1. History of Recent Updates to ACS Cancer Early Detection Guidelines

| CANCER SITE       | YEAR                                      |
|-------------------|-------------------------------------------|
| Breast cancer     | 2003, Complete update<sup>6</sup>         |
|                   | 2007, Guidelines for MRI use in high-risk women<sup>7</sup> |
|                   | 2011, Update anticipated                  |
| Cervical cancer   | 2002, Complete update<sup>15</sup>        |
|                   | 2007, Guidelines for HPV vaccine use<sup>9</sup> |
|                   | 2011, Update anticipated                  |
| Colorectal cancer | 2001, Complete update<sup>10</sup>        |
|                   | 2003, Technology update<sup>11</sup>      |
|                   | 2006, Update for postpolypectomy and post-colorectal cancer resection surveillance<sup>12,13</sup> |
|                   | 2008, Complete update<sup>8</sup>         |
| Endometrial cancer| 2001, Guidance for counseling, shared decision-making, and high-risk women<sup>10</sup> |
| Lung cancer       | 2001, Guidance for shared decision-making<sup>10</sup> |
| Prostate cancer   | 2001, Guidance for shared decision-making related to testing for early detection and screening recommendations for higher risk men<sup>10</sup> |
|                   | 2010, Complete update<sup>4</sup>         |
| Skin cancer       | 2011, Update anticipated                  |

ACS indicates American Cancer Society; MRI, magnetic resonance imaging; HPV, human papillomavirus.
| CANCER SITE   | POPULATION                  | TEST OR PROCEDURE                                                                 | FREQUENCY |
|--------------|-----------------------------|-----------------------------------------------------------------------------------|-----------|
| Breast       | Women, aged ≥20 y           | BSE                                                                               | Beginning in their early 20s, women should be told about the benefits and limitations of BSE. The importance of the prompt reporting of any new breast symptoms to a health professional should be emphasized. Women who choose to do BSE should receive instruction and have their technique reviewed on the occasion of a periodic health examination. It is acceptable for women to choose not to do BSE or to do BSE irregularly. |
| CBE          | For women in their 20s and 30s, it is recommended that CBE be part of a periodic health examination, preferably at least every 3 y. Asymptomatic women aged ≥40 y should continue to receive a CBE as part of a periodic health examination, preferably annually. |
| Mammography  | Begin annual mammography at age 40 y. |                                                                                   |           |
| Colorectal   | Men and women, aged ≥50 y    | FOBT with at least 50% test sensitivity for cancer, or FIT with at least 50% test sensitivity for cancer, or | Annual, starting at age 50 y. |
|              |                             | Stool DNA test                                                                    | Interval uncertain, starting at age 50 y. |
|              |                             | FSIG, or                                                                          | Every 5 y, starting at age 50 y. |
|              |                             | FOBT or FIT and FSIG, or                                                          | Annual FOBT or FIT, and FSIG every 5 y, starting at age 50 y. |
|              |                             | DCBE, or                                                                          | Every 5 y, starting at age 50 y. |
|              |                             | Colonoscopy                                                                       | Every 10 y, starting at age 50 y. |
|              |                             | CT colonography                                                                    | Every 5 y, starting at age 50 y. |
| Prostate     | Men, aged ≥50 y              | DRE and PSA                                                                       | 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 benefits, risks, and uncertainties associated with prostate cancer screening. Prostate cancer screening should not occur without an informed decision making process. |
| Cervix       | Women, aged ≥21 y, or 3 y after first intercourse, whichever comes first | Pap test                                                                          | Cervical cancer screening should begin approximately 3 y after a woman begins having vaginal intercourse, but no later than aged 21 y. Screening should be done every y with conventional Pap tests or every 2 y using liquid-based Pap tests. At or after age 30 y, women who have had 3 normal test results in a row may get screened every 2 to 3 y with cervical cytology (either conventional or liquid-based Pap test) alone, or every 3 y with an HPV DNA test plus cervical cytology. Women aged ≥70 y who have had ≥3 normal Pap tests and no abnormal Pap tests in the last 10 y and women who have had a total hysterectomy may choose to stop cervical cancer screening. |
| Endometrial  | Women, at menopause         | At the time of menopause, women at average risk should be informed about risks and symptoms of endometrial cancer and strongly encouraged to report any unexpected bleeding or spotting to their physicians. |
| Cancer-related checkup | Men and women, aged ≥20 y     | On the occasion of a periodic health examination, the cancer-related checkup should include examination for cancers of the thyroid, testicles, ovaries, lymph nodes, oral cavity, and skin, as well as health counseling about tobacco, sun exposure, diet and nutrition, risk factors, sexual practices, and environmental and occupational exposures. |

ACS indicates American Cancer Society; BSE, breast self-examination; CBE, clinical breast examination; FOBT, fecal occult blood test; FIT, fecal immunochemical test; FSIG, flexible sigmoidoscopy; DCBE, double-contrast barium enema; CT, computed tomography; DRE, digital rectal examination; PSA, prostate-specific antigen; Pap, Papanicolaou; HPV, human papillomavirus.

*Beginning at age 40 years, annual CBE should be performed prior to mammography.

FOBT as it is sometimes performed in physicians’ offices, with the single stool sample collected on a fingertip during a DRE, is not an adequate substitute for the recommended at-home procedure of collecting 2 samples from 3 consecutive specimens. Toilet bowl FOBT tests also are not recommended. In comparison with guaiac-based tests for the detection of occult blood, immunochemical tests are more patient-friendly, and are likely to be equal or better in sensitivity and specificity. There is no justification for repeating FOBT in response to an initial positive finding.

Information should be provided to men about the benefits and limitations of testing so that an informed decision can be made with the clinician’s assistance.
The ACS recommends that average-risk women should begin annual mammography at the age of 40 years. Women also should be informed about the scientific evidence demonstrating the value of detecting breast cancer before symptoms develop, and that the balance of benefits to possible harms strongly supports the value of screening and the importance of adhering to a schedule of regular mammograms. The benefits of mammography include a reduction in the risk of dying from breast cancer and, if breast cancer is detected early, less aggressive surgery (ie, lumpectomy vs mastectomy), less aggressive adjuvant therapy, and a greater range of treatment options. Women also should be told about the limitations of mammography, specifically that mammography will not detect all breast cancers, and that some breast cancers detected with mammography may still have poor prognosis. Furthermore, women should be informed about the potential for false-positive results, some of which may not be resolved with additional imaging, and if not, a biopsy will be required to rule out the possibility of breast cancer.

There is no specific upper age at which mammography screening should be discontinued. Rather, the decision to stop regular mammography screening should be individualized based on the potential for false-positive results, some of which may not be resolved with additional imaging, and if not, a biopsy will be required to rule out the possibility of breast cancer.

In 2007, the ACS issued new guidelines for women who were known or likely carriers of a BRCA 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 MRI starting at age 30 years are recommended for women with a known BRCA mutation, women who are untested but have a first-degree relative with a BRCA mutation, or women with an approximately 20% to 25% or greater lifetime risk of breast cancer based on specialized breast cancer risk estimation models capable of pedigree analysis of first-degree and second-degree relatives on both the maternal and paternal side. Although individual lifetime risk estimates generated from the Gail model can exceed the threshold of approximately 20% or greater risk to age 90 years, the elevated risk may be due to risk factors other than family history. To estimate risk of breast cancer in women with a significant family history who have not undergone genetic testing and do not have an affected relative who has tested positive, health professionals should use specialized software that can address family history in first-degree and second-degree relatives on both the maternal and paternal side. There are several models that can estimate risk based on complex family histories and assist clinicians in estimating breast cancer risk or the likelihood that a BRCA mutation is present, including the Claus model, Tyrer-Cuzick model, BRCAPRO, and the Breast and Ovarian Analysis of Disease Incidence and Carrier Estimation Algorithm (BOADICEA) model. Some of these models also can accommodate complex family histories and conventional risk factors, such as reproductive history or a history of prior breast biopsy. A link to supplemental material related to these models is included in the online publication (available at: http://caonline.amcancersoc.org/cgi/data/57/2/75/DC1/1).

Although MRI may eventually prove to be cost-effective and advantageous for women at elevated risk due to other combinations of risk factors, at this time recommendations for annual screening mammography and MRI are based strictly on known or estimated high-risk mutation carrier status or history of high-dose radiation therapy at a young age. The expert panel concluded that there was insufficient evidence to recommend for or against MRI screening in women with a 15% to 20% lifetime risk as defined by these same family history-based risk estimation models, or women with a history of ductal or lobular carcinoma in situ, a history of biopsy-proven proliferative lesions, or extremely dense breasts. MRI is not recommended for women at average risk, although investigations are underway to determine whether MRI should be considered for other higher risk groups.
Screening for Cervical Cancer

ACS guidelines for cervical cancer screening were last updated in 2002 (Table 2)\(^\text{15}\) and recommendations for the use of prophylactic human papillomavirus (HPV) vaccines, including policy and implementation issues, were published in January 2007.\(^\text{9}\)

The screening guidelines recommend different surveillance strategies and options based on a woman’s age, her screening history, other risk factors, and the choice of screening tests. Screening for cervical cancer should begin approximately 3 years after first vaginal intercourse, but no later than age 21 years. Until age 30 years, women at average risk should receive either annual screening with conventional cervical cytology smears, or biennial screening using liquid-based cytology. After age 30 years, a woman who has had 3 consecutive technically satisfactory Papanicolaou (Pap) tests with normal/negative results may chose to either undergo screening every 2 to 3 years using either conventional or liquid-based cytology, or undergo screening every 3 years with the combination of HPV DNA testing and conventional or liquid-based cytology. Women who chose to undergo HPV DNA testing should be informed that 1) HPV infection usually is not detectable or harmful; 2) almost everyone who has had sexual intercourse has been exposed to HPV and that infection is very common; 3) a positive HPV test result does not reflect the presence of a sexually transmitted disease, but rather a sexually acquired infection; and 4) a positive HPV test result does not indicate the presence of cancer, nor will the large majority of women who test positive for an HPV infection develop advanced cervical neoplasia.

Women who have an intact cervix and who are in good health should continue screening until age 70 years, and afterward may elect to stop screening if they have had no abnormal/positive cytology tests within the 10-year period before age 70 years, and if there is documentation that the 3 most recent Pap tests were technically satisfactory and interpreted as normal. However, screening after age 70 years is recommended for women in good health who have not been previously screened, women for whom information about previous screening is unavailable, and women for whom there is a low likelihood of past screening.

Women with a history of cervical cancer or in utero exposure to diethylstilbestrol (DES) should follow the same guidelines as average-risk women before age 30 years, and should continue with that protocol after age 30 years. Women who are immunocompromised by organ transplantation, chemotherapy, chronic corticosteroid treatment, or who are human immunodeficiency virus (HIV) positive should be tested twice during the first year after diagnosis and annually thereafter, according to guidelines from the US Public Health Service and Infectious Disease Society of America.\(^\text{36}\) There is no specific age at which to stop screening for women with a history of cervical cancer, those with in utero exposure to DES, and women who are immunocompromised (including HIV-positive women). As with women at average risk, women in these risk groups should continue cervical cancer screening for as long as they are in reasonably good health and would benefit from early detection and treatment.

Cervical cancer screening is not indicated for women who have undergone removal of the cervix or the entire uterus for benign gynecologic disease. However, a woman with a history of cervical intraepithelial neoplasia (CIN) of type 2/3, or a woman for whom it is not possible to document the absence of CIN2/3 before or as the indication for either trachelectomy or hysterectomy, should continue to be screened until she has a 10-year history of no abnormal/positive cytology tests, including documentation that the 3 most recent consecutive tests were technically satisfactory and interpreted as normal/negative. Women who have had a hysterectomy and who also have a history of in utero DES exposure and/or a history of cervical cancer should continue screening after hysterectomy for as long as they are in reasonably good health and would benefit from early detection and treatment. Average-risk women who have had a subtotal (supracervical) hysterectomy should be screened following the recommendations for average-risk women who have not undergone hysterectomy.

The ACS recommends routine HPV vaccination principally for females ages 11 to 12 years, but also for females ages 13 to 18 years to “catch up” those who missed the opportunity to be vaccinated, or those who need to complete the vaccination series. The guidelines state that there are insufficient data to recommend for or against the universal vaccination of females ages 19 to 26 years. Women in this age group who are interested in undergoing
vaccination should talk with a health care professional about their risk of previous HPV exposure and the potential benefit of vaccination. Screening for CIN and cancer should continue in both vaccinated and unvaccinated women according to current ACS early detection guidelines for cervical cancer. According to the 2009 National Immunization Survey of Teens, 44.3% of US female adolescents ages 13 to 17 years initiated the HPV vaccination series (ie, had at least 1 of 3 shots as recommended for the HPV vaccine), and 26.7% had completed 3 doses.37,38

**Screening and Surveillance for the Early Detection of Adenoma Polyps and CRC**

Guidelines for screening and surveillance for the early detection of adenomatous polyps and CRC in average-risk adults were updated in 2008 in an evidence-based consensus process that included the ACS, the US Multi-Society Task Force (USMSTF) on Colorectal Cancer (which comprises representatives of the American College of Gastroenterology, the American Gastroenterological Association, and the American Society for Gastrointestinal Endoscopy), and the American College of Radiology (Table 2).14 Recommendations for adults at increased and high risk were last updated in 2001,10 and in 2006, the ACS and the USMSTF issued a joint guideline update for postpolypectomy and post-CRC resection surveillance.13,39

Recommended CRC screening tests are grouped into 2 categories: 1) tests that primarily detect cancer, which include both guaiac fecal occult blood testing (gFOBT) and fecal immunochemical test (FIT)-based tests and testing stool for exfoliated DNA (sDNA); and 2) tests that can detect cancer and advanced lesions, which include the endoscopic examinations and radiological examinations (ie, FSIG, colonoscopy [CSPY], double-contrast barium enema [DCBE], and computed tomography colonography [CT colonography, or virtual colonoscopy]). This distinction is intended to help primary care physicians support informed decision-making and to help the public understand the features, advantages, and disadvantages that distinguish these 2 groups of screening tests. Furthermore, the guidelines state that although all recommended tests are acceptable options, the prevention of CRC is the greater priority in screening. Although there have been calls to state a preference for CSPY above all other options,40 studies have shown that even after a process of shared decision-making, adults show considerable variation in the test they chose, a pattern that has persisted over a period of the growing use of CRC screening and a shift toward CSPY as the most common screening test.41-43 Furthermore, in addition to variable preferences, access to all testing options also is variable due to institutional policies, insurance coverage, time to appointment, and geographic distance.

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) annual high sensitivity gFOBT or FIT, following the manufacturer’s recommendations for specimen collection; 2) sDNA, for which at this time there is uncertainty with regard to the screening interval; 3) FSIG every 5 years; 4) CSPY every 10 years; 5) DCBE every 5 years; or 6) CT colonography every 5 years. Single-panel gFOBT performed in the medical office using a stool sample collected during a digital rectal examination (DRE) is not a recommended option for CRC screening due to its very low sensitivity for advanced adenomas and cancer.44 For similar reasons, the updated guideline recommends discontinuing the use of older, lower sensitivity versions of the guaiac test (such as Hemoccult II; Beckman Coulter, Brea, Calif) in favor of newer, high-sensitivity gFOBT (such as Hemoccult SENSa; Beckman Coulter).14 An additional option for regular screening is annual stool blood testing (gFOBT or FIT) with FSIG performed every 5 years. 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 unless there is a commitment to annual at-home testing with adherence to the manufacturer’s instructions, the limited sensitivity observed with one-time testing would make stool testing a poor choice.

The ACS and other organizations recommend more intensive surveillance for individuals at higher risk of CRC.10,12,13,45 Individuals at higher risk of 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 due to a history of inflammatory bowel disease of significant duration; or 5) individuals at significantly higher risk due to a known or suspected presence of 1 of 2 hereditary syndromes, specifically hereditary nonpolyposis CRC (HNPCC) or familial adenomatous polyposis (FAP). For these individuals, increased surveillance generally means a specific recommendation for CSPY if available, and may include more frequent examinations and examinations beginning at an earlier age. As noted earlier, an update in recommendations for follow-up CSPY for individuals with a history of adenomatous polyps or a personal history of curative-intent resection of CRC was issued in 2006 jointly by the ACS and the USMSTF.13,39

In 2010, the results of a randomized controlled trial of once-only FSIG screening conducted in the United Kingdom were published.46 The trial randomized over 170,000 men and women ages 55 to 64 years to a group invited to one-time screening with FSIG and a control group that received usual care. The results, comparing the group invited to screening with the control group after 11 years of follow-up, showed statistically significant reductions in CRC incidence (−23%) and mortality (−31%). In the protocol analysis that compared men and women who actually attended screening with the control group after an adjustment for selection bias, there was a 33% reduction in CRC incidence and a 43% reduction in mortality. Nearly all of the incidence reduction was for lesions in the distal colon (36%), with only a 2% reduction in incidence noted for lesions occurring in the proximal colon. The investigators were interested in the incidence reduction in both the distal and proximal colon because participants who underwent screening and had an advanced adenoma diagnosed in the distal colon were judged to be at high risk of additional advanced neoplasia beyond the reach of the FSIG and were referred for total CSPY. The study was published on May 8, 2010 and on October 3, 2010, Prime Minister David Cameron announced a commitment to introduce CRC screening with FSIG in 2011, subject to approval by the UK National Screening Committee.47 An accompanying editorial celebrated the availability of new evidence from an experimental design (the results of 2 other FSIG randomized trials are pending), and also suggested that this report and other recent reports showing much poorer screening outcomes in patients with lesions in the proximal colon suggested that there may be little benefit from any endoscopic screening in the proximal colon.48 In addition to the very small reduction in incidence in the proximal colon observed in the UK once only FSIG study,46 other recent studies also have shown differential effects of endoscopy in the distal versus proximal colon. In Germany, Brenner et al compared the prevalence of advanced CRC lesions among 2701 adults who had not undergone previous CSPY with 586 adults who had undergone CSPY within the previous 10 years.49 Although an overall reduction in the incidence of advanced lesions was observed (prevalence ratio, 0.52), it was due entirely to a reduction in the prevalence of left-sided lesions, and no reduction in the prevalence of right-sided lesions was observed.49 In a case-control study, Baxter et al examined the association between exposure to CSPY and CRC death in Ontario, Canada.50 Exposure to CSPY was associated with a lower CRC mortality rate from left-sided CRC (odds ratio, 0.33), but no effect was observed for CRC deaths from right-sided CRC.

Are these data sufficient to conclude that endoscopy, including both FSIG and CSPY, are only effective as screening tools for advanced neoplasia in the distal colon? In the UK study, only adults with high-risk polyps in the distal colon (5%) were referred for CSPY, which means there would be little chance of observing a statistically significant mortality reduction associated with referral to total CSPY based on the prevalence of any polyp in the distal colon. However, the German and Canadian studies49,50 compared the protective effect of CSPY in the total colon, and observed a strong protective effect for lesions in the distal colon, but not the proximal colon. The authors described several limitations in their study designs that could have favored observing a differential benefit associated with a protective effect for distal neoplasia versus proximal neoplasia, and there were other reasons having to do with the performance of the examination in the proximal colon versus the distal colon that could
have influenced the findings. These performance issues are a function of both differences in the biology and appearance of colorectal neoplasia in the proximal colon (ie, a greater proportion of lesions are sessile [flat] and not as easily visualized as pedunculated [with a stalk] lesions), as well as the greater technical challenge of examining the proximal colon compared with the distal colon, including failure to reach the cecum. To the extent that these biological and technical factors are associated with poorer performance in the proximal colon, the challenge would be to determine the extent to which they can be overcome with different techniques and greater attention to quality assurance. The accumulation of evidence showing weaker protective effects from CSPY in the proximal colon compared with the distal colon needs to be taken seriously. Further investigations to compare endoscopic screening in the proximal and distal colon are needed to determine whether CSPY as it is done today, or with new techniques, provides a sufficiently high enough incremental advantage over other CRC screening tests to justify the costs.

Screening for Early Prostate Cancer Detection

In 2010, the ACS updated its 2001 guideline for the early detection of prostate cancer.4,10 The guideline 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 DRE and serum PSA after receiving information about the benefits, risks, and uncertainties associated with prostate cancer screening (Table 3).4 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 regarding 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, due to the 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 (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 of 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, of his risk of high-grade prostate cancer.4

Historically, the evidence about the value of testing for early prostate cancer detection has been regarded as insufficient to recommend that men at average or even high risk undergo regular screening, especially given the knowledge that some prostate cancers are not life-threatening and treatment for prostate cancer is associated with a significant rate of adverse side effects.51 Although results from some observational and quasi-experimental studies have been interpreted as indicating a benefit from prostate cancer screening, other studies have been interpreted as indicating that screening was not beneficial, and generally there was consensus that results from the
randomized trials would be the ultimate arbiter of whether screening could be recommended.\textsuperscript{52} Although many anticipated that results from these randomized trials would answer the fundamental question about the efficacy of screening, the initial findings have done little to resolve the current uncertainty about the value of screening for early prostate cancer detection. Although the Prostate, Lung, Colorectal and Ovarian Cancer Screening (PLCO) Trial did not observe a reduction in prostate cancer deaths in the group invited to screening, the European Randomized Study of Screening for Prostate Cancer (ERSPC) observed a statistically significant 20% reduction in prostate cancer deaths. Wolf et al provided a summary of the differences in the 2 trials that may partly explain the different outcomes.\textsuperscript{4} Although the ERSPC and the PLCO trials observed different outcomes with respect to the association between an invitation to screening and a reduction in prostate cancer mortality, investigators from both trials concluded that there were considerable human costs associated with preventing a death from prostate cancer. Investigators from ERSPC estimated that 1068 men needed to be screened twice over a 9-year period to save one life, and 48 men needed to be treated for prostate cancer to save one life. However, this estimate is likely higher than eventually will be measured due to the short period of follow-up thus far.

Since the publication of the 2010 ACS guideline, additional evidence has accumulated related to the efficacy of prostate cancer screening. Hugosson et al recently reported results from a study of 20,000 Swedish men between the ages of 50 and 74 years who were randomized to a group that received an invitation for PSA testing every 2 years or to a control group that was not invited to testing.\textsuperscript{53} A significant number of these men (11,852) were included in the Swedish cohort of the ERSPC.\textsuperscript{54} After 14 years of follow-up (significantly longer than the median 9 years in the ERSPC and 7 years in the PLCO trials), the Swedish researchers observed 44% fewer prostate cancer deaths in the group invited to screening compared with the control group. They also estimated a significantly smaller number needed to screen (293 men) and number needed to diagnose (12 men) to save one life compared with the values estimated in the ERSPC, which is consistent with

**TABLE 3. Core Elements of the Information to be Provided to Men to Assist With Their Decision Regarding Prostate Cancer Screening**\textsuperscript{4}

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

PSA indicates prostate-specific antigen; DRE, digital rectal examination.
the expectation that with additional years of follow-up these numbers would become more favorable. However, similar to ERSPC, this study found that the majority of the mortality benefit achieved through screening occurs after 10 years, leading the authors to emphasize that policy makers should be cautious about promoting screening for all elderly men. In addition, and very importantly, at 14 years of follow-up, the control and screened groups had the exact same overall mortality.

Djulbegovic et al performed a systematic review and meta-analysis of randomized controlled trials comparing the outcomes of screening for prostate cancer with the PSA test (with or without DRE) versus no screening.\(^5\) They analyzed findings from 6 studies (the 3 discussed above and 3 earlier trials) that included data from more than 387,000 participants. Their review determined that although screening was associated with both an increased likelihood of receiving a diagnosis of prostate cancer and a diagnosis of stage I disease, there was no significant effect on the risk of death from prostate cancer or on overall mortality. Each of the studies included in the meta-analysis was judged to suffer from one or more significant methodological flaws. The researchers also point out that none of these trials reported on the impact of screening and treatment on participants’ quality of life, nor on screen-associated harms.

These new data from the randomized trials were not regarded as sufficient to significantly modify the existing guidelines for testing for prostate cancer detection. The new guideline continues to emphasize informed and shared decision-making as the basis for decisions about prostate cancer screening. Prostate cancer screening, diagnosis, and treatment are inextricably intertwined, and there is a significant body of evidence documenting the risks and harms associated with screening and treatment. Screen-related harms include anxiety associated with testing or with an abnormal test result,\(^5\) as well as issues resulting from the imprecision of the PSA test. PSA is found in small amounts in the blood of most men, and most instances of PSA elevation are due to noncancerous causes (primarily benign prostatic hyperplasia or infection). Such “false-positive” findings are extremely common; approximately 2 of every 3 men who are evaluated for a PSA level greater than 4.0 ng/mL will ultimately be determined not to have cancer.\(^5\) This determination is usually made only after these men have undergone biopsy of their prostate gland, a procedure that is uncomfortable and may result in bleeding or infectious complications.\(^5\) In addition to false-positive findings, PSA testing is frequently associated with “false-negative” results. End-of-study biopsies of men followed in the Prostate Cancer Prevention Trial found prostate cancer in 27% of men who never experienced a PSA level greater than 4.0 ng/mL during the course of the study.\(^6\) In addition, cancer was found in 10% of men whose PSA level never exceeded 1.0 ng/mL throughout the 7 years of the study.\(^6\) False-negative results create the potential for mistaken reassurance and the delayed diagnosis of clinically significant cancers.

Increased rates of diagnosis have been demonstrated in all randomized controlled trials of prostate cancer screening, consistent with both lead time bias but also some overdiagnosis. Overdiagnosis is the detection of a cancer during screening that would not likely have become known in the absence of screening and thus would never be life-threatening. Overdiagnosis contributes to the risk and harms associated with screening and treatment. Prostate cancer is, in many instances, a slow-growing disease. It is estimated that up to 40% of cancers found through screening would never have caused harm had they gone undetected.\(^6\) However, once detected, the majority of these cancers will be treated. Prostate cancer treatment often leads to life-altering complications and side effects, including sexual dysfunction and difficulties with urinary and bowel function.

In view of these well-documented risks and harms, and uncertainty regarding the benefit of screening for an individual, the ACS expert committee chose to emphasize the importance of providing men with sufficient information to allow them to make an individual decision whether to be screened based on their personal preferences and values. The importance of informed and shared decision-making has been a central element of ACS recommendations on prostate cancer early detection since 2001,\(^1\) and is a cross-cutting theme in the recent guidelines from medical and public health organizations including the US Preventive Services Task Force (USPSTF) and the American Urological Association.\(^2,3\) Despite this consensus on the importance of informed and shared decision-making, studies
have shown that informed and shared decision-making measures are inconsistently utilized in many clinical practices and that, when such discussions take place, the content varies widely and frequently falls short of accepted standards. In an effort to address these shortcomings, the 2010 ACS guideline for the first time provides detailed recommendations to clinicians concerning the core factors related to prostate cancer screening and treatment that should be shared with men to enable them to make a truly informed decision whether to be screened.

Screening for Endometrial Cancer

In 2001, the ACS concluded that there was insufficient evidence to recommend screening for endometrial cancer in women at average risk or who were at an increased risk due to a history of unopposed estrogen therapy, tamoxifen therapy, late menopause, nulliparity, infertility or failure to ovulate, obesity, diabetes, or hypertension.10 The ACS recommends that women at average and increased risk should be informed about the risks and symptoms (in particular, unexpected bleeding and spotting) of endometrial cancer at the onset of menopause, and should be strongly encouraged to immediately report these symptoms to their physicians (Table 2). Women at very high risk of endometrial cancer due to 1) known HNPCC genetic mutation carrier status; 2) a 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 a suspected autosomal dominant predisposition to colorectal cancer should consider beginning annual testing for early endometrial cancer detection at age 35 years. The evaluation of endometrial histology with endometrial biopsy is still the standard for determining the status of the endometrium.66 Women at high risk should be informed that the recommendation for screening is based on expert opinion, and they also should be informed about the potential benefits, risks, and limitations of testing for early endometrial cancer detection.

Testing for Early Lung Cancer Detection

At present, neither the ACS nor any other medical/scientific organization recommends testing for early lung cancer detection in asymptomatic individuals. However, the ACS historically has recognized that patients at high risk of lung cancer due to significant exposure to tobacco smoke or occupational exposures may decide to undergo testing for early lung cancer detection on an individual basis after consultation with their physicians. Because of the likelihood that a growing number of individuals would seek testing for early lung cancer detection with spiral CT, the ACS issued a narrative in 2001 emphasizing the importance of shared decision-making regarding testing for early lung cancer detection. The narrative stressed that patients understand the limits of the current evidence about lung cancer screening and the possibility of a range of outcomes from screening, including nondefinitive findings, which can be associated with increased anxiety.

The narrative not only emphasized the importance of discussing potential benefits and harms, but also the importance of testing in settings with multidisciplinary expertise in diagnostic workup and treatment. At this time, prospective trials to evaluate the efficacy of lung cancer screening are underway in the United States and Europe. An update to the current narrative about shared decision-making related to testing for early lung cancer detection is not anticipated until results from prospective clinical trials currently underway are available, which are expected sometime in the coming decade.

Testing for Early Ovarian Cancer Detection

Although the annual incidence of ovarian cancer is low compared with breast cancer and precursor lesions of the cervix, it is the most lethal of the gynecologic cancers. Fewer than half of women diagnosed with ovarian cancer survive longer than 5 years, and although the 5-year survival rate for patients with localized ovarian cancer is greater than 90%, only 15% of all patients are diagnosed with localized disease. The poor prognosis of symptomatic disease and the very favorable survival among women diagnosed with localized ovarian cancer has led to efforts to develop an effective screening protocol. In addition, investigators also have proposed strategies to diagnose symptomatic disease earlier in its natural history.

Currently, there is no proven effective screening strategy for the early detection of ovarian cancer, and
neither the ACS nor any other organization recommends screening asymptomatic women at average risk. Screening and diagnostic methods for ovarian cancer include pelvic examination, CA 125 antigen as a tumor marker, transvaginal ultrasound (TVU), and, potentially, multimarker panels and bioinformatic analysis of proteomic patterns. Presently, several investigations are underway that may lead to a screening strategy for asymptomatic women, as well as more specific protocols for the evaluation of women who present with symptoms of ovarian cancer.

The sensitivity and specificity of pelvic examination for the detection of symptomatic ovarian cancer are not well established, but are poor and do not support physical examination as a screening method. However, in the absence of a strategy to screen for asymptomatic disease, recent evaluations into presenting symptoms suggest that a more favorable diagnosis may be possible in some cases if early symptoms are properly evaluated. Goff et al cited the prevailing belief that symptoms of ovarian cancer typically are not present until the disease has reached an advanced stage. These symptoms include abdominal, pelvic, and back pain; bloating and swelling; and urinary symptoms. Goff et al compared self-reported symptoms among ovarian cancer patients with a control group consisting of women seeking care in primary care clinics and observed significantly elevated odds for abdominal size, bloating, urinary urgency, and pelvic pain. Although these symptoms were present in both cases and controls, cases were distinguished by more rapid onset, frequency, and severity. The authors also observed that these symptoms were often present while the disease was still in an early, more curable stage. Smith et al noted that patient reports that symptoms were present for a significant period before diagnosis were often dismissed as recall bias. To determine the degree to which this is true, they linked Medicare claims data with the California Surveillance, Epidemiology, and End Results database to compare the prevalence of 4 symptom-related diagnoses and procedure codes (abdominal pain, swelling, gastrointestinal symptoms, and pelvic pain) during 3-month periods up to 36 months before the diagnosis of ovarian cancer. Codes were compared for 1985 women with ovarian cancer; 6024 women with localized breast cancer; and 10,941 age-matched, Medicare-enrolled women without cancer. Compared with cancer-free controls or breast cancer patients, ovarian cancer patients had elevated odds for all 4 symptom groups more than 6 months prior to diagnosis, and were more likely to have undergone abdominal imaging and gastrointestinal procedures than pelvic imaging or CA 125 testing. These and other findings led to a consensus statement issued by the Gynecologic Cancer Foundation and signed by 40 organizations that recommended that women with daily symptoms lasting more than a few weeks of bloating, pelvic or abdominal pain, difficulty eating or feeling full quickly, or urinary symptoms should see their physician because prompt medical evaluation may lead to diagnosis at the “earliest possible stage of the disease.” Efforts to develop a symptom index show promise for the earlier diagnosis of symptomatic disease, but the constellation of common symptoms still is more strongly associated with advanced disease than early stage disease, and the large majority of women referred for further evaluation will not have ovarian cancer.

CA 125 is a tumor-associated antigen, and the CA 125 test measures levels of this antigen in serum. Although the main use of CA 125 is for surveillance in women who have already undergone surgery for ovarian cancer, it has been evaluated for use as a screening test. CA 125 has limited sensitivity and specificity; although CA 125 levels are increased in many women with ovarian cancer, only half of early ovarian cancers produce enough CA 125 to cause a positive test, and noncancerous diseases of the ovaries and other cancers, as well as other noncancerous influences, also can increase the blood levels of CA 125. Retrospective analysis has shown that patients with ovarian cancer had rising levels of CA 125 within the normal range, which investigators have incorporated into clinical risk stratification algorithms, but even sequential measures are regarded as too insensitive to be used as a stand-alone test.

TVU is capable of detecting small ovarian masses and may distinguish some benign masses from some malignant adnexal masses, although it still only poorly predicts which masses are cancers and which are due to benign diseases of the ovary. As an independent test, TVU has shown poor performance in the detection of ovarian cancer in average-risk or high-risk women. The UK Collaborative Trial of
Ovarian Cancer Screening (UKCTOCS) assessed TVU alone in one of its trial arms, screening over 48,000 postmenopausal women. Approximately 12% of the women receiving TVU at the initial screen needed a repeat test, 3.9% required a clinical evaluation, and 1.8% underwent surgery. Among the 845 women who underwent surgery, 45 cancers were detected, including 12 early-stage and 12 late-stage tumors. As with CA 125, TVU is not sufficiently accurate to use as a stand-alone test.

There have been attempts to develop a blood test for ovarian cancer based on measuring genes, proteins, or multiple marker assays that may be present in higher or lower amounts in women with ovarian cancer compared with women who do not have ovarian cancer. This is a relatively new area of investigation that is accumulating promising results, but still requires prospective studies for validation.

Two large, prospective, randomized trials are studying screening of average-risk women with a combination of CA 125 and TVU. In the PLCO trial, 34,000 women ages 55 to 74 years were eligible for annual screening and 30,000 participated in at least one round of screening. After 4 rounds of screening, the ratio of surgery to cancer was 19.5 to 1, with 72% of cancers detected at an advanced stage. TVU resulted in more false-positive results, but also detected earlier stage cancers, and 3.5% of all women screened underwent surgery, primarily oophorectomy, that did not lead to a cancer diagnosis. In the UKCTOCS, 202,638 postmenopausal women ages 50 to 74 years were randomly assigned to either a control group (n = 101,359); a group to receive multimodal screening, including annual CA 125 screening with a risk of ovarian cancer algorithm and TVU as a second-line test (n = 50,640); or a group to receive annual screening with TVU only (n = 50,639). Overall, 9% of women in the multimodal group and 12% of women in the TVU-only group required a repeat test, with 0.3% of women in the multimodal group and 3.9% of women in the TVU-only group requiring further evaluation. Only 0.2% underwent surgery, with a surgery to cancer ratio of 2.3, and 48% of the invasive cancers detected were at an early stage. Although the authors regarded the screening experience as demonstrating the feasibility of ovarian cancer screening, especially the more favorable results from the multimodal protocol, they cautioned that long-term follow-up is necessary to determine whether screening is associated with a reduction in ovarian cancer mortality.

The low prevalence of this disease and the difficulty of confirming diagnosis without intraperitoneal sampling necessitate screening and diagnostic tests with high sensitivity for early stage disease and very high specificity. Currently, there are no screening tests that have yet been shown to have sufficient accuracy and benefit to be used for screening in the general population although, as noted earlier, prospective trials using different algorithms are underway, and assessment of more novel tumor markers likely will be possible with serum collected in these studies.

Although no organization recommends screening average-risk women for ovarian cancer, in 1994, a National Institutes of Health Consensus Panel concluded that women with 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 mutations on BRCA1 and BRCA2 (including breast-ovarian cancer syndrome, site-specific ovarian cancer syndrome, and HNPCC), 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 Cancer-Related Checkup

Periodic encounters with clinicians, either for acute care or for checkups, offer the potential for health counseling, cancer screening, and case finding. When individuals see a health care professional for a preventive health examination, there is an opportunity for more comprehensive counseling and testing and indeed, it has been consistently observed that individuals who have had a recent preventive health
examination are more likely to have undergone cancer screening. These encounters should include the performance of or referral for conventional cancer screening tests as appropriate by age and gender, as described earlier, but also are an opportunity for case-finding examinations of the thyroid, testicles, ovaries, lymph nodes, oral region, and skin. In addition, self-examination techniques or increased awareness about the signs and symptoms of skin cancer, breast cancer, or testicular cancer can be discussed. Health counseling may include guidance about smoking cessation, diet, physical activity, and shared decision-making about cancer screening, or testing for early cancer detection for cancer sites for which population-based screening is not yet recommended. Whereas in the past the ACS recommended a “cancer-related checkup” in a manner that implied a stand-alone examination, the recommendation now stresses that the occasion of a general periodic health examination provides a good opportunity to address examinations and counseling that could lead to the prevention and early detection of cancer (Table 2).

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

National cancer screening estimates based on the 2008 NHIS are presented in Table 4. In this narrative, we document the extent of change (percentage increases or decreases) in cancer screening prevalence between 2005 and 2008. We also, using the most recent survey data (2008), describe differences in cancer screening by race and ethnicity and 2 socioeconomic indicators (having health insurance and level of educational attainment) strongly associated with access and use of medical/preventive services. These data and this narrative were included in the 2010 update, but also are included here for convenience.

Cancer Screening Trends

Screening for Cervical Cancer

In 2008, 78.3% of women reported undergoing a Pap test within the past 3 years. In 2005, this prevalence was 79.6%, indicating a small decrease of −1.3 percentage points.

Non-Hispanic white (79.6%) and Non-Hispanic black women (81.5%) were more likely to report having a Pap test within the past 3 years than Asian American (63.8%) or Hispanic women (75%). On the 2 measures of socioeconomic status, women with health care coverage are much more likely to report receipt of a Pap test within the past 3 years (81%) compared with uninsured women (60.6%), and women with more than 12 years of education (more than a high school diploma) are more likely to have had a Pap test within the past 3 years than those with a high school degree or less.

Between 2002 and 2003, leading organizations that issue guidelines for cervical cancer screening modified their recommendations to reflect the accumulation of evidence about the natural history of the disease, including the important role of persistent infection with high-risk HPV subtypes as well as clinical factors that would affect the frequency of testing and an age at which to stop testing. Yabroff et al reported the results of a survey of physicians conducted in 2006 through 2007 that attempted to measure adherence with the new guidelines by questioning physicians about Pap testing in the context of a series of clinical vignettes. Although greater than 90% of physicians reported providing Pap testing to their patients, the survey demonstrated considerable variation in practice and beliefs about Pap testing by specialty. Although a majority of physicians used liquid-based cytology (80.5%), obstetricians/gynecologists were significantly more likely to use liquid-based cytology (92.1%) compared with family or general practice physicians (82.5%) or internists (70.9%). All 3 specialty groups regarded liquid-based cytology as more effective in reducing cervical cancer deaths compared with conventional Pap testing. Although there are several advantages (greater laboratory productivity, fewer unsatisfactory specimens, ability to use the same sample for HPV DNA testing and for computerized screening) and disadvantages (greater cost) with liquid-based testing, comparisons of the diagnostic accuracy of the 2 tests found no significant advantage in sensitivity or specificity for liquid-based cytology over conventional Pap testing. The ACS, USPSTF, and American College of Obstetrics and Gynecology all recommend beginning Pap testing at age 21 years, or 3 years after the onset of sexual intercourse, whichever comes
Although over 90% of physicians surveyed reported that they would initiate annual testing for an 18-year-old presenting for her first gynecological visit who began having vaginal intercourse 3 years previously, 82% would initiate annual testing for an 18-year-old presenting for a

---

**TABLE 4. Prevalence (%) of Recent Cancer Screening Examinations Among US Adults (2005 vs. 2008), and by Race and Ethnicity, Health Insurance Coverage, and Educational Level: National Health Interview Survey, 2008**

| US ADULTS | RACE AND ETHNICITY |
|-----------|---------------------|
| YEAR | YEAR | ABSOLUTE % CHANGE | WHITE, NON-HISPANIC | BLACK, NON-HISPANIC | ASIAN AMERICAN | HISPANIC |
| 2005* | SE | 2008 | SE | (2008-2005) | SE | SE | SE | SE |
| Colorectal cancer |  |  | | | | | | |
| (adults aged ≥50 y) | | | | | | | | |
| Either a FSIG or colonoscopyb | 43.1 | 0.6 | 50.2 | 0.6 | 7.1 | 52.7 | 0.7 | 47.3 | 1.8 | 42.6 | 3.1 | 34.6 | 1.9 |
| FOBT (home kit)c | 12.1 | 0.4 | 10.0 | 0.4 | -2.1 | 10.3 | 0.6 | 12.9 | 0.9 | 12.1 | 1.6 | 7.8 | 1.0 |
| FOBT or endoscopyd | 46.8 | 0.6 | 53.2 | 0.6 | 6.4 | 56.0 | 0.7 | 48.9 | 1.7 | 47.8 | 3.2 | 37.2 | 1.7 |
| Breast cancer (women aged ≥40 y) |  |  | | | | | | |
| Mammograme | 51.2 | 0.6 | 53.0 | 0.7 | 1.8 | 54.2 | 0.9 | 52.2 | 1.9 | 52.2 | 3.2 | 46.8 | 2.0 |
| Cervical cancer (women aged ≥18 y) |  |  | | | | | | |
| Pap testf | 79.6 | 0.4 | 78.3 | 0.5 | -1.3 | 79.6 | 0.7 | 81.5 | 1.3 | 63.8 | 2.3 | 75.0 | 1.5 |
| Prostate cancer (men aged ≥50 y) |  |  | | | | | | |
| PSAg | 40.7 | 0.9 | 44.1 | 1.0 | 3.4 | 46.6 | 1.2 | 36.6 | 2.9 | 34.7 | 3.9 | 32.7 | 2.9 |

| HEALTH INSURANCE | EDUCATIONAL LEVEL (YEARS OF EDUCATION) |
|-------------------|----------------------------------------|
| HAVE HEALTH INSURANCE | NO HEALTH INSURANCE | ≤11 YEARS | 12 YEARS | 13 to 15 YEARS | ≥16 YEARS |
| SE | SE | SE | SE | SE | SE |
| Colorectal cancer |  |  | | | | |
| (adults aged ≥50 y) | | | | | | |
| Either a FSIG or colonoscopyb | 52.6 | 0.7 | 12.7 | 2.5 | 34.0 | 1.4 | 48.1 | 1.1 | 52.2 | 1.2 | 61.9 | 1.2 |
| FOBT (home kit)c | 10.3 | 0.4 | 8.8 | 3.9 | 8.1 | 0.8 | 8.1 | 0.6 | 12.9 | 0.8 | 10.8 | 0.7 |
| FOBT or endoscopyd | 55.7 | 0.7 | 19.5 | 4.4 | 37.3 | 1.4 | 50.8 | 1.1 | 56.3 | 1.2 | 64.5 | 1.2 |
| Breast cancer |  |  | | | | |
| (women aged ≥40 y) | | | | | | |
| Mammograme | 56.2 | 0.7 | 26.0 | 3.8 | 40.1 | 1.8 | 49.2 | 1.4 | 55.2 | 1.3 | 64.5 | 1.3 |
| Cervical cancer |  |  | | | | |
| (women aged ≥18 y) | | | | | | |
| Pap testf | 81.0 | 0.5 | 60.6 | 2.4 | 68.3 | 1.6 | 73.7 | 1.2 | 81.1 | 0.8 | 84.8 | 1.0 |
| Prostate cancer |  |  | | | | |
| (men aged ≥50 y) | | | | | | |
| PSAg | 46.2 | 1.0 | 9.1 | 2.1 | 29.8 | 2.0 | 37.6 | 1.7 | 48.1 | 2.1 | 55.7 | 1.8 |

**SE indicates standard error; FOBT, fecal occult blood test; Pap, Papanicolaou; PSA, prostate-specific antigen.**

*Prevalence estimates (National Health Interview Survey 2005) are shown here to describe the difference in absolute percentage change in cancer screening use during the period between 2005 and 2008. Prevalence was weighted and age-adjusted using the 2000 Census.

*Recent FSIG within the preceding 5 y or colonoscopy test within the preceding 10 y.

*Recent FOBT using a home kit test performed within the preceding y.

*Recent FOBT using a home kit test performed within the preceding y OR recent FSIG or colonoscopy test performed within the preceding 10 y.

*Women aged ≥40 y who had a mammogram within the last y.

*Women who had a Pap test within the preceding 3 y.

*A PSA test within the past y for men who have not been told they had prostate cancer.

Source: National Health Interview Survey 2005 and 2008 (National Center for Health Statistics, Centers for Disease Control and Prevention).
first gynecological visit with first intercourse just one month ago, and approximately one-third would initiate annual testing for an 18-year-old with no prior sexual intercourse.93 For a 35-year-old woman with no new sexual partner within the past 5 years and 3 consecutive normal Pap tests, a patient for whom all 3 guidelines endorse testing every 3 years, approximately one-third of physicians each reported that they would recommend screening annually, biennially, or every-3 or more years. Only approximately half of physicians reported that they would discontinue periodic Pap testing for women without an intact cervix, for those with a life-limiting fatal condition, or for women aged older than 70 years with no new partners and 3 previous normal Pap tests. Although most physicians reported a Pap testing decision consistent with national guidelines in one scenario (the 18-year-old with first sexual intercourse more than 3 years previously), a composite measure of all 4 vignettes showed that less than one-third followed national guidelines consistently.

**Screening for Breast Cancer**

In a previous report, it had been noted that during the period between 2000 and 2005, there had been a small decline of 3.4% in the reported use of mammography in the past 2 years among women aged 40 years and older. Based on the recent 2008 NHIS updates, it appears that declining trends (whether in the past 2 years or the past year) are no longer apparent but instead are rising overall and across groups for the recent period of 2005 through 2008. We report here the prevalence of mammogram use in the past year because this measure of utilization closely reflects ACS guidelines. In 2008, 53% of women reported having had a mammogram within the past year. In 2005, this prevalence was 51.2%, indicating an increase of nearly 2 percentage points (Table 3). All racial and ethnic groups except Hispanic women (46.8%) had a prevalence of mammogram use (in the past year) ranging between 52% and 54% in 2008. Uninsured women were approximately half as likely to report having had a mammogram in the past year compared with insured women (26% vs 56.2%). Reporting having had a mammogram in the past year increases with increasing level of educational attainment.

Because national surveys do not assess repeat mammography utilization, recent utilization is commonly interpreted as the proportion of women receiving regular mammograms. Adherence with regular mammography is important because it ensures the greatest likelihood of detecting breast cancer at an early stage. Gierisch et al investigated factors associated with adherence with regular mammography, referred to as “maintenance mammography,” over 3 years, as well as factors associated with nonadherence with maintenance mammography.97 This was a secondary analysis of a study focused on increasing adherence with mammography, but the investigators focused on 1493 women who were in the control group to avoid confounding from the primary study intervention. Participants were women who had been screened with mammography within the past 8 to 9 months, and the data from the study were from interviews conducted at 12, 24, and 36 months, as well as claims data from their insurance provider. All women were enrolled in the North Carolina State Health Plan for Teachers and State Employees and had access to mammography. Over half of the sample (54%) were nonadherent with regular mammography over the 3-year period. Women ages 40 to 49 years were less likely to be adherent with regular mammography compared with women aged 50 years and older, and women who perceived their health status to be fair or poor, women who were somewhat dissatisfied with their previous mammography experience, and women who perceived one or more barriers to getting a mammography were significantly less likely to be adherent with regular mammography. What is most notable about fewer than half of the women in this sample being adherent with regular mammography over a 3-year period is that nearly all women had reported a source of usual care, had health insurance, had recent mammography, received annual mammography reminders, and held positive attitudes toward mammography, all factors associated with a higher likelihood of having had a recent mammogram.97 The authors conclude that although health behavior researchers more commonly focus on promoting health behavior change, an emphasis on sustaining behavior change is equally important. These data indicate that some groups of women need more than a physician recommendation and periodic reminders to be adherent with regular mammography.
Screening for CRC

As in the previous report, it had been noted that screening rates for CRC were increasing from 2000 through 2005. This rising trend has continued for the most recent period of 2000 through 2008. Table 3 shows data for the following CRC cancer screening modalities: use of an FOBT home kit test in the past year, use of either CRC endoscopy tests (FSIG in the past 5 years or CSPY in the past 10 years), and combinations of CRC testing (either FOBT and/or endoscopy). No data from NHIS were available about other recommended modalities (CT colonography, barium enema, etc.)

In 2008, the prevalence of having had recent screening with either FOBT or endoscopy was 53.2%. In 2005, this prevalence was 46.8%, indicating a 6.4% increase over the 3-year period. The increasing trend in the use of CRC testing appears to be largely driven by the increasing proportion of age-eligible individuals reporting having undergone a CSPY examination, a trend enhanced by both aggressive attempts to motivate screening as well as increased coverage for the procedure. However, despite improvement, recent data have indicated that factors such as race and ethnicity and socioeconomic status (either having health care coverage or educational level attained) are related to the likelihood of having had CRC testing (either an FOBT or endoscopy).

Two recent studies from the 2006 through 2007 National Survey of Primary Care Physicians’ Recommendations and Practices for Cancer Screening provide data on screening recommendations and practices of US physicians, as well as comparisons from a similar survey conducted between 1999 and 2000. Since 1999 through 2000, there has been a dramatic change in the CRC test most commonly recommended to adults, as well as perceptions of which test is the most effective. In 1999 through 2000, FOBT was the screening test most commonly recommended by physicians (95%), followed by FSIG (78%), CSPY (38%), and DCBE (14%). In the most recent survey, CSPY was the screening test recommended by most physicians (95%), followed by FOBT (80%), FSIG (26%), and DCBE (9%).

Over the period between 1999 and 2000 and 2006 and 2007, perceived effectiveness of CSPY increased, whereas perceived effectiveness of FOBT and FSIG declined. With respect to following guidelines recommended by national organizations, which recommend that average-risk individuals begin screening at age 50 years, nearly one-third of physicians reported that they recommended starting FOBT at age 40 years, whereas greater than 90% recommended starting CSPY after age 50 years. Only 4% of physicians reported that they performed FSIG, down from 29% in 1999 through 2000. Most physicians (87%) recommended that FOBT be done annually, and a little more than half (54%) recommended CSPY every 10 years, each of which is consistent with national guidelines. Only 17% of physicians’ recommendations for the frequency of CSPY were consistent with the guidelines in 1999 through 2000. Nearly all physicians reported that they routinely recommend CRC screening to their patients. Half of physicians recommend 2 screening options (FOBT and CSPY), and 1 in 5 recommend 3 options, with FOBT, FSIG, and CSPY being the most common choices. Nevertheless, although 99% of physicians recommend CRC screening to their patients, only 61% reported that their practice had implemented guidelines for CRC screening (ie, had a practice policy to attempt to ensure that age-eligible adults were offered screening), only 30% reported the use of any reminder system (chart flags, computer prompts, etc.), and only 12% reported that they receive a report about CRC screening rates for their panel of patients.

Although FOBT use has declined over the past decade, it still is the second most common CRC screening test recommended by physicians, and was the most commonly recommended test based on reports in the 1999 through 2000 National Survey of Primary Care Physicians’ Recommendations and Practices for Cancer Screening survey. However, additional analysis of these data by Nadel et al revealed serious, widespread problems in the way physicians conducted FOBT screening and follow-up of positive tests. Although manufacturers of gFOBT recommended a take-home protocol in which stool samples would be collected from 3 consecutive bowel movements, 3 of 4 physicians reported performing stool testing in the office some or all of the time with a single stool specimen collected during a DRE. Collins et al showed that the in-office, single-specimen test had very low sensitivity for cancer (less than 10%) and all...
advanced neoplasias (less than 5%). Follow-up of positive FOBT also departed from national guidelines. Approximately one-third of physicians reported following a positive FOBT with a second FOBT, and FSIG was more commonly recommended for the follow-up of a positive FOBT than CSPY. In an accompanying editorial to the results of these 2 studies, Sox commented that CRC mortality rates might be considerably lower if physicians followed recommended standards and procedures. ACS guidelines for CRC screening also have strongly discouraged in-office FOBT. In the follow-up survey, Nadel et al reported that in-office testing still is widely used, with 1 in 4 physicians reporting only using in-office tests, and an additional 53% of physicians reporting using both in-office tests and take-home tests. Fewer physicians reported repeating FOBT after a positive FOBT test (18%), and most now reported that they would follow a positive FOBT with CSPY. Fewer than half of physicians (44%) who use take-home tests had a system to track test completion. The authors concluded that the persistence of the inappropriate use of FOBT in CRC screening and the lack of supporting systems to track test completion seriously limited the effectiveness of stool testing and reduced the potential to save lives.

Testing for Early Prostate Cancer Detection
In 2008, the prevalence of PSA test use in the past year was 44.1%, which is 3.4% higher than in 2005 (40.7%). Similar to CRC testing, individual characteristics such as race and ethnicity and socioeconomic factors (either having health care coverage or educational level attained) are related to the likelihood of having had a PSA test in the past year. It is important to note that the testing rate does not reflect adherence with ACS guidelines because no population surveillance system is able to track use of PSA testing conditional on the outcome of a process of shared decision-making between the patient and the health care provider.

The Impact of the Patient Protection and Affordable Care Act, on Cancer Screening
In March 2010, Congress passed and the President signed the Patient Protection and Affordable Care Act, which includes several provisions that will improve access to recommended clinical preventive services including screening for breast, cervical, and CRC. The Act includes provisions that are expected to increase uptake of cancer screening in currently insured adults, and previously uninsured adults. Beginning on or after September 23, 2010, new private plans and insurance policies are required to cover a range of recommended preventive services with no out-of-pocket costs. These services include breast, cervical, and CRC screening. The frequency and intervals for coverage are based on the most current USPSTF recommendations for average-risk individuals, with the exception of mammography, for which coverage is based on the 2002 USPSTF recommendations rather than those issued in 2009. A description of the new coverage requirements are shown in Table 5, and are similar to the current ACS screening guidelines (Table 2).

The Act also includes changes in Medicare coverage for prevention and early detection. On January 1, 2011, Medicare will begin to cover screening for breast, cervical, and CRC without cost-sharing. Currently, Medicare beneficiaries pay 20% to 25% cost-sharing for mammograms, sigmoidoscopies, and colonoscopies. Studies have shown that cost-sharing is a significant barrier to the nation’s senior citizens’ utilization of Medicare benefits. In addition, a new annual wellness visit benefit will include a health risk assessment, which also is expected to increase utilization of screening based on the strong association between recent cancer screening and having had a recent checkup.

For Medicaid programs, the Patient Protection and Affordable Care Act provides the option to include preventive services graded “A” or “B” by the USPSTF in their Medicaid program benefits. States that provide these services will receive a 1% increase in the Federal Medical Assistance Percentage, effective January 1, 2013.

In addition to new coverage for clinical preventive services, the Patient Protection and Affordable Care Act takes major steps to elevate prevention as a national priority to help transform our “sick care” system to one that emphasizes health and wellness. The Patient Protection and Affordable Care Act establishes an interagency council that will develop a prevention strategy for the nation, and establishes a new Prevention and Public Health Fund, with...
annual appropriations increasing to $2 billion in fiscal year 2015 and beyond.

For many Americans, the Patient Protection and Affordable Care Act will greatly improve access to cancer screening by eliminating coverage and financial barriers. However, although the bill will expand coverage, it does so gradually, and even by the end of this decade, universal coverage will not be achieved. Furthermore, because the law relies on states to establish health insurance exchanges and gives them considerably leeway in how exchanges are structured, favorable projections for reducing the number of uninsured individuals may be unrealized. Thus, safety net programs like the National Breast and Cervical Cancer Early Detection Program are still necessary to ensure those without insurance coverage can have access to screening.

Discussion

Cross-section surveys indicate that a majority of US adults have undergone recent screening for breast, cervical, and CRC, although rates persistently are lower than optimal. Other data sources cited here and elsewhere paint a less optimistic picture with respect to both underscreening and overscreening in the population, including failure to maintain adherence with screening over successive intervals, failure to adhere to standard protocols, and failure to implement either simple or complex systems to ensure patients are regularly and properly screened for cancer, and followed if screening tests are positive. In previous annual updates, we have cited a range of factors associated with the current model of primary care that are clear disincentives to the delivery of preventive health, including lack of time, lack of reimbursement, lack of continuity of care, and lack of cost recovery for systems that have been shown to increase uptake of regular screening.

As noted by Wender and Altshuler, greater progress in reducing cancer morbidity and mortality will require 2 forms of health care reform: reform in health care coverage and health care delivery. These 2 reforms are underway today and hold the promise of improving rates of regular cancer screening. As described above, the Patient Protection and Affordable Care Act includes provisions that are expected to increase uptake of breast, cervical, and CRC screening in currently insured adults and previously uninsured adults. Second, there is recognition that the current “sick-care” model that dominates primary care is not conducive to delivering recommended preventive care measures, both in terms of available time and personnel, and other enabling factors and incentives. In response to the clear need to do better at both chronic disease management and prevention, there is a rapidly growing movement to implement patient-centered medical homes, which emphasize having a personal physician, physician-directed teams, whole-person orientation, coordination of care, quality and safety, and enhanced access. At least in theory, the design of the medical home is specifically enhanced to ensure that patient care is comprehensive and includes both prevention and chronic disease management and the personnel and systems to support the model. As Ferrante et al have shown, and as was highlighted by Gierisch et al, attentiveness to personal barriers as well as systems are needed to ensure regular cancer screening.

### Table 5. Cancer Screening Coverage Requirements for New Private Health Plans

| CANCER SCREENING          | DESCRIPTION                                                                                                                                                                                                 | USPSTF GRADE | DATE IN EFFECT |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|
| Breast cancer screening   | The USPSTF recommends screening mammography for women, with or without CBE, every 1-2 y for women aged ≥40 y.                                                                                             | B            | September 2002  |
| Cervical cancer screening | The USPSTF strongly recommends screening for cervical cancer in women who have been sexually active and have a cervix.                                                                                         | A            | January 2003    |
| Colorectal cancer screening | The USPSTF recommends screening for colorectal cancer using FOBT, FSIG, or colonoscopy in adults, beginning at age 50 y and continuing until age 75 y. The risks and benefits of these screening methods vary. | A            | October 2008    |

USPSTF, US Preventive Services Task Force; CBE, clinical breast examination; FOBT, fecal occult blood test.
References

1. Eddy D. ACS report on the cancer-related health checkup. CA Cancer J Clin. 1980;30:193-240.

2. American Cancer Society. Cancer of the lung. CA Cancer J Clin. 1980;30:199-207.

3. Stamey TA, Yang N, Hay AR, McNeal JE, Freihis FS, Redwine E. Prostate-specific antigen as a serum marker for adenocarcinoma of the prostate. N Engl J Med. 1987;317:420-426.

4. 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.

5. Briss P, Rimer B, Reiley B, et al. Promoting informed decisions about cancer screening in communities and healthcare systems. Am J Prev Med. 2004;26:67-80.

6. Smith RA, Saslow D, Sawyer KA, et al. American Cancer Society guidelines for breast cancer screening: update 2003. CA Cancer J Clin. 2003;53:141-167.

7. Saslow D, Boetes C, Burke W, et al. American Cancer Society guidelines for cancer screening with MRI as an adjunct to mammography. CA Cancer J Clin. 2007;57:7-58.

8. Smith RA, Cokkinides V, von Eschenbach AC, et al. American Cancer Society guidelines for the early detection of cancer. CA Cancer J Clin. 2002;52:8-22.

9. 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.

10. 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. CA Cancer J Clin. 2001;51:38-75; quiz 77-80.

11. Levin B, Brooks D, Smith RA, Stone A. Emerging technologies in screening for colorectal cancer: CT colonography, immunochemical fecal occult blood tests, and stool screening using molecular markers. CA Cancer J Clin. 2003;53:44-55.

12. 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 185-166.

13. 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.

14. 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.

15. 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.

16. Jemal A, Center MM, DeSantis C, Ward EM. Global patterns of cancer incidence and mortality rates and trends. Cancer Epidemiol Biomarkers Prev. 2010;19:1893-1907.

17. Ramsey SD, Yoon P, Moonesinghe R, Khoury MJ. Population-based study of the prevalence of family history of cancer: implications for cancer screening and prevention. Genet Med. 2006;8:571-575.

18. Hall JI, Middlebrook A, Coughlin SS. Population prevalence of first-degree family history of breast and ovarian cancer in the United States: implications for genetic testing. Open Health Serv Policy J. 2008;3:34-47.

19. U.S. Preventive Services Task Force. Genetic risk assessment and BRCA mutation testing for breast and ovarian cancer susceptibility: recommendation statement. Ann Intern Med. 2005;143:355-361.

20. Velicer CM, Taplin S. Genetic testing for breast cancer: where are health care providers in the decision process? Genet Med. 2001;3:111-133.

21. Schlich-Bakker KJ, ten Kroode HF, Warnam-Rodenhuis CC, van den Bout J, Ausems MG. Barriers to participating in genetic counseling and BRCA testing during primary mammography for breast cancer. Genet Med. 2007;9:766-777.

22. Condit CM. Public understandings of genetics and health. Clin Genet. 2010;77:1-9.

23. Smith RA. Commentary: breast self examination: do we really know what we think we know? BMJ-USA. 2003;13:168-169.

24. Rauscher GH, Ferrans CE, Kaiser K, Campbell RT, Calhoun EE, Warnecke RB. Misconceptions about breast lumps and delayed medical presentation in urban breast cancer patients. Cancer Epidermid Biomarkers Prev. 2010;19:640-647.

25. Tabar L, Fagerberg G, Duffy SW, Day NE, Gad A, Gronoff O. Update of the Swedish two-county program of mammographic screening. Radiol Clin North Am. 1992;30:187-210.

26. Tabar L, Duffy SW, Vitak B, Chen HH, Prevost TC. The natural history of breast carcinoma: what have we learned from screening? Cancer. 1996;96:449-462.

27. Duffy SW, Tabar L, Olsen AH, et al. Absolute numbers of lives saved and overdiagnosis in breast cancer screening, from a randomized trial and from the Breast Cancer Screening Programme in England. J Med Screen. 2010;17:25-30.

28. Wang L, Covinsky KE. Breast screening in elderly patients: a framework for individualized decision making. JAMA. 2001;285:2750-2756.

29. Wang L, Bollinger RR, Brawley OW, et al. Breast cancer screening among previously unscreened African and Caucasian women: findings from a triangulation mixed methods investigation. J Community Health. 2009;34:79-89.

30. Leard LE, Savides TJ, Ganiats TG. Patient preferences for colorectal cancer screening. J Fam Pract. 1997;45:211-218.

31. Collins JF, Lieberman DA, Rosenthal DD, Fetterson MD. Factors influencing choices for colorectal cancer screening among previously unscreened African Americans: findings from a triangulation mixed methods investigation. J Community Health. 2009;34:79-89.

32. Tyrer J, Duffy SW, Cuzick J. A breast cancer prediction model incorporating family history and personal risk factors. Stat Med. 2004;23:1111-1130.

33. Berry DA, Iversen ES Jr, Gudbjartsson DF, et al. BRCAPRO validation, sensitivity of genetic testing of BRCA1/BRCA2, and prevalence of other breast cancer susceptibility genes. J Clin Oncol. 2002;20:2701-2712.

34. Antoniou AC, Pharoah PP, Smith P, Easton DF. The BOADICEA model of genetic susceptibility to breast and ovarian cancer. Br J Cancer. 2004;91:1580-1590.

35. Weinstein SP, Loc-Soto AR, Conant EF, Rosen M, Thomas K, Schnall MD. Multimodality screening of high-risk women: a prospective cohort study. J Clin Oncol. 2009;27:6124-6128.

36. Centers for Disease Control and Prevention. USPHS/IDSA guidelines for the prevention of opportunistic infections in persons infected with human immunodeficiency virus: a summary. MMWR Morb Mortal Wkly Rep. 1995;44(RR-8):1-34.

37. Centers for Disease Control and Prevention. National, state, and local area vaccination coverage among adolescents aged 13-17 years—United States, 2009. MMWR Morb Mortal Wkly Rep. 2010;59:1018-1023.

38. Jain N, Stokley S, Yankey D. Vaccination coverage among adolescents aged 13-17 years—United States, 2007. MMWR Morb Mortal Wkly Rep. 2008;57:1100-1103.

39. Rex DK, Kahi CJ, Levin B, et al. Guidelines for colonoscopy surveillance after cancer resection: a consensus update by the American Cancer Society and the US Multi-Society Task Force on Colorectal Cancer. Gastroenterology. 2006;130:1865-1871.

40. Rex DK, Johnson DA, Anderson JC, Schoenfeld PS, Burke CA, Inadomi JM. American College of Gastroenterology guidelines for colorectal cancer screening 2009 [corrected]. Am J Gastroenterol. 2009;104:739-750.

41. Leard LE, Savides TJ, Ganiats TG. Patient preferences for colorectal cancer screening. J Fam Pract. 1997;45:211-218.

42. Ruffin MT 4th, Creswell JW, Jimbo M, Fetterson MD. Factors influencing choices for colorectal cancer screening among previously unscreened African Americans: findings from a triangulation mixed methods investigation. J Community Health. 2009;34:79-89.

43. Iamaeda A, Bender D, Fraenkel L. What is most important to patients when deciding about colorectal screening? J Gen Intern Med. 2010;25:688-693.

44. Collins JF, Lieberman DA, Durbín 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 practice. Ann Intern Med. 2005;142:81-85.

45. Winawer S, Fletcher R, Rex D, et al. Colorectal cancer screening and surveillance: clinical guidelines and rationale—Update based on new evidence. Gastroenterology. 2003;124:544-560.

46. Atkinson WS, Edwards R, Kralj-Hans I, et al. Once-only flexible sigmoidoscopy screening in prevention of colorectal cancer: a multicentre randomised controlled trial. Lancet. 2010;375:1624-1633.

47. BBC News. David Cameron Announces Cancer Screening Boost. Available at: http://www.bbc.co.uk/news/uk-politics-11461495. Accessed October 3, 2010.
48. Ransohoff DF. Can endoscopy protect against colorectal cancer? An RCT. Lancet. 2010;375:1582-1584.
49. Brenner H, Hoffmeister M, Arndt V, Stegmaier C, Attenhofen L, Haug U. Protection from right- and left-sided colorectal neoplasms after colorectal polypectomy: population-based study. J Natl Cancer Inst. 2010;102:89-95.
50. Baxter NN, Goldwasser MA, Paszat LF, Saskin R, Urbach DR, Rabeneck L. Association of colorectal cancer and death from colorectal cancer. Ann Intern Med. 2009;150:1-8.
51. Potosky AL, Davis WW, Hoffman RM, et al. Five-year outcomes after prostatectomy or radiotherapy for prostate cancer: the prostate cancer outcomes study. J Natl Cancer Inst. 2004;96:1358-1367.
52. Boyle P. Prostate specific antigen (PSA) testing as screening for prostate cancer: the current controversy. Ann Oncol. 1998;9:1263-1264.
53. Hugosson J, Carlsson S, Aus G, et al. Mortality results from the Goteborg randomised population-based prostate-cancer screening trial. Lancet Oncol. 2010;11:725-732.
54. Schroder FH, Hugosson J, Roobol MJ, et al. Screening and prostate-cancer mortality in a randomized European study. N Engl J Med. 2009;360:1320-1328.
55. Djulbegovic M, Beyth RJ, Neuberger MM, et al. Screening for prostate cancer: systematic review and meta-analysis of randomised controlled trials. BMJ. 2010;341:c4543.
56. Carlsson S, Aus G, Wessman C, Hugosson J. Anxiety associated with prostate cancer screening with special reference to men with a positive screening test (elevated PSA)-Results from a prospective, population-based, randomised study. Eur J Cancer. 2007;43:2109-2116.
57. Gustafsson O, Theorell T, Norming U, et al. Prevention and early detection clinical trialeconomic opportunities for primary care providers and their patients. CA Cancer J Clin. 2003;53:82-101.
58. Pastorino U, Bellomi M, Landoni C, et al. Early lung-cancer detection with spiral CT and positron emission tomography in heavy smokers: 2-year results. Lancet. 2003;362:593-597.
59. Ford LG, Mnisamian LM, McCaskill-Stevens W, Pisano ED, Sullivan D, Smith RA. Prevention and early detection clinical trials: overall design and findings from base-line screening [see comments]. Lancet. 1999;354:99-105.
60. Henschke CI, McCauley DI, Yankelevitz DF, et al. Early Lung Cancer Action Project: overall design and findings from baseline screening [see comments]. Lancet. 1999;354:99-105.
61. International Early Lung Cancer Action Program Investigators; Henschke CI, Yankelevitz DF, Libby DM, Paasmanter MW, Smith JP, Miettinen OS. Survival of patients with stage I lung cancer detected on CT screening. N Engl J Med. 2006;355:1763-1771.
62. Byrne MM, Weisfeld J, Roberts MS. Anxiety, fear of cancer, and perceived risk of cancer following lung cancer screening. Med Decis Making. 2008;28:917-925.
63. American Cancer Society. Cancer Facts and Figures 2010. Atlanta, GA: American Cancer Society; 2010.
64. Allekruze SF, Kosary CL, Krapcho M, et al. Survival of patients with stage I lung cancer detected on CT screening. N Engl J Med. 2006;355:1763-1771.
65. Byrne MM, Weisfeld J, Roberts MS. Anxiety, fear of cancer, and perceived risk of cancer following lung cancer screening. Med Decis Making. 2008;28:917-925.
66. Early Lung Cancer Action Program Investigators; Henschke CI, Yankelevitz DF, Libby DM, Paasmanter MW, Smith JP, Miettinen OS. Survival of patients with stage I lung cancer detected on CT screening. N Engl J Med. 2006;355:1763-1771.
67. American Cancer Society. Cancer Facts and Figures 2010. Atlanta, GA: American Cancer Society; 2010.
68. Allekruze SF, Kosary CL, Krapcho M, et al. Survival of patients with stage I lung cancer detected on CT screening. N Engl J Med. 2006;355:1763-1771.
69. Hoffman RM, Cooper 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.
70. Walker JL, Nunez ER. Endometrial cancer. In: Kramer BS, Gohagan JK, Prorok PC, eds. Screening: Theory and Practice. New York: Marcel Dekker, Inc. 1999:531-566.
71. Henschke CI, McCauley DI, Yankelevitz DF, et al. Early Lung Cancer Action Project: overall design and findings from baseline screening [see comments]. Lancet. 1999;354:99-105.
72. Pastorino U, Bellomi M, Landoni C, et al. Early lung-cancer detection with spiral CT and positron emission tomography in heavy smokers: 2-year results. Lancet. 2003;362:593-597.
73. Ford LG, Mnisamian LM, McCaskill-Stevens W, Pisano ED, Sullivan D, Smith RA. Prevention and early detection clinical trials: overall design and findings from baseline screening [see comments]. Lancet. 1999;354:99-105.
74. International Early Lung Cancer Action Program Investigators; Henschke CI, Yankelevitz DF, Libby DM, Paasmanter MW, Smith JP, Miettinen OS. Survival of patients with stage I lung cancer detected on CT screening. N Engl J Med. 2006;355:1763-1771.
75. Fishman DA, Cohen L, Blank SV, et al. The role of ultrasound evaluation in the detection of early-stage prostate cancer. Am J Surg. 2005;192:1214-1221; discussion 1221–1212.
76. Menon U, Gentry-Maharaj A, Hallett R, et al. Sensitivity and specificity of multimodal and ultrasound screening for early detection of prostate cancer, and stage distribution of detected cancers: results of the prevalence screen of the UK Collaborative Trial of Ovarian Cancer Screening (UKCTOCS). Lancet Oncol. 2009;10:327-340.
77. Ren J, Cai H, Li Y, et al. Tumor markers for early detection of ovarian cancer. Expert Rev Mol Diagn. 2010;10:787-798.
78. Prorok PC, Andriole GL, Bresalier RS, et al. Design of the National Prostate, Lung, Colorectal and Ovarian (PLCO) Cancer Screening Trial. Control Clin Trials. 2000;21(6 suppl):273S-309S.
79. Partridge AH, Winer EP. On mammography-more agreement than disagreement. N Engl J Med. 2009;361:2499-2501.
80. National Institutes of Health Consensus Development Conference Statement. Ovarian cancer: screening, treatment, and follow-up. NIH Consensus Development Conference Panel. Bethesda, MD: National Institutes of Health; 1994–1.3
81. Maciosek MV, Coffield AB, Edwards NM, et al. Priorities among effective clinical preventive services: results of a systematic review and analysis. Am J Prev Med. 2006;31:52-61.
82. Fenton JJ, Cai Y, Weiss NS, et al. Delivery of cancer screening: how important is the preventive health examination? Arch Intern Med. 2007;167:580-585.
83. Smith RA, Kokkinides V, Brooks D, Salsow D, Brawley OW. Cancer screening in the United States, 2010: a review of current American Cancer Society guidelines and issues in cancer screening. CA Cancer J Clin. 2010;60:99-119.
84. Yabroff KR, Saraiya M, Meissner HI, et al. Preventive care: guidelines and core components. CA Cancer J Clin. 2011;61:8-30.
controlled trial. JAMA. 2009;302:1757-1764.

95. ACOG Committee on Practice Bulletins. ACOG Practice Bulletin: clinical management guidelines for obstetrician-gynecologists. Number 45, August 2003. Cervical cytology screening (replaces committee opinion 152, March 1995). Obstet Gynecol. 2003;102:417-427.

96. Screening for Cervical Cancer, Topic Page. January 2003. U.S. Preventive Services Task Force. http://www.usrpreventiveservicestaskforce.org/uspstf/uspcerv.htm, accessed 10-02-2010.

97. Gierisch JM, Earp JA, Brewer NT, Rimer BK. Longitudinal predictors of nonadherence to maintenance of mammography. Cancer Epidemiol Biomarkers Prev. 2010;19:1103-1111.

98. Smith RA, Cokkinides V, Brawley OW. Cancer screening in the United States, 2008: a review of current American Cancer Society guidelines and cancer screening issues. CA Cancer J Clin. 2008;58:161-179.

99. Centers for Disease Control and Prevention (CDC). Use of colorectal cancer tests–United States, 2002, 2004, and 2006. MMWR Morb Mortal Wkly Rep. 2008;57:253-258.

100. Schenck AP, Peacock SC, Klabunde CN, Lapin P, Coan JF, Brown ML. Trends in colorectal cancer test use in the medicare population, 1998-2005. Am J Prev Med. 2009;37:1-7.

101. Maxwell AE, Crespi CM. Trends in colorectal cancer screening utilization among ethnic groups in California: are we closing the gap? Cancer Epidemiol Biomarkers Prev. 2009;18:752-759.

102. Doubeni CA, Laiyemo AO, Reed G, Field TS, Fletcher RH. Socioeconomic and racial patterns of colorectal cancer screening among Medicare enrollees in 2000 to 2005. Cancer Epidemiol Biomarkers Prev. 2009;18:2170-2175.

103. Klabunde CN, Lanier D, Nadel MR, McLeod C, Yuan G, Vernon SW. Colorectal cancer screening by primary care physicians: recommendations and practices, 2006-2007. Am J Prev Med. 2009;37:8-16.

104. Klabunde CN, Lanier D, Nadel MR, McLeod C, Yuan G, Vernon SW. Colorectal cancer screening by primary care physicians: recommendations and practices, 2006–2007. Am J Prev Med. 2009;37:8-16.

105. Nadel MR, Shapiro JA, Klabunde CN, et al. A national survey of primary care physicians’ methods for screening for fecal occult blood. Ann Intern Med. 2005;142:86-94.

106. Nadel MR, Berkowitz Z, Klabunde CN, Smith RA, Coughlin SS, White MC. Fecal occult blood testing beliefs and practices of U.S. primary care physicians: serious deviations from evidence-based recommendations. J Gen Intern Med. 2010;25:833-839.

107. Sox HC. Office-based testing for fecal occult blood; do only in case of emergency. Ann Intern Med. 2005;142:146-148.

108. Byers T, Levin B, Rothenberger D, Dodd GD, Smith RA. American Cancer Society guidelines for screening and surveillance for colorectal polyps and cancer: update 1997. American Cancer Society Detection and Treatment Advisory Group on Colorectal Cancer. CA Cancer J Clin. 1997;47:154-160.

109. U.S. Preventive Services Task Force. Screening for breast cancer: recommendations and rationale. Ann Intern Med. 2002;137:344-346.

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

111. Lowes R. Senate Guarantees Coverage of Mammograms, Other Screenings in Healthcare Reform Bill. Available at: http://www.medscape.com/viewarticle/ 713342. Accessed October 2, 2010.

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

113. Trivedi AN, Rakowski W, Ayanian JZ. Effect of cost sharing on screening mammography in Medicare health plans. N Engl J Med. 2008;358:375-383.

114. Fenton JJ, Elmore JG, Buist DS, Reid RJ, Tancer DJ, Baldwin LM. Longitudinal adherence with fecal occult blood test screening in community practice. Ann Fam Med. 2010;8:397-401.

115. Wender RC, Altshuler M. Can the medical home reduce cancer morbidity and mortality? Prim Care. 2009;36:445-456; table of contents.

116. Yarnall KS, Ostbye T, Krause KM, Pollak KI, Gradison M, Michener JL. Family physicians as team leaders: "time" to share the care. Prev Chronic Dis. 2009;6:A59.

117. Yarnall KS, Pollak KI, Ostbye T, Krause KM, Michener JL. Primary care: is there enough time for prevention? Am J Public Health. 2003;93:635-641.

118. American Academy of Family Physicians (AAFP), American Academy of Pediatrics (AAP), American College of Physicians (ACP), American Osteopathic Association (AOA). Joint principles of the patient-centered medical home. 2007. Source URL: http://www.pcpcc.net/content/joint-principles-patient-centered-medical-home. Accessed 10-02-2010.

119. Ferman JM, Balasubramanian BA, Hudson SV, Crabtree BF. Principles of the patient-centered medical home and preventive services delivery. Ann Fam Med. 2010; 8:108-116.