

Mammograms

Key Points

- A mammogram is an x-ray picture of the breast. Screening mammograms are used to check for breast cancer in women who have no signs or symptoms of the disease. Diagnostic mammograms are used to check for breast cancer after a lump or other sign or symptom of the disease has been found (see Question 1).
- Results from randomized clinical trials and other studies show that screening mammography can help reduce the number of deaths from breast cancer among women ages 40 to 74 (see Question 3).
- Screening mammography is also associated with potential harms, including false-negative results, false-positive results, the diagnosis and treatment of cancers and ductal carcinoma in situ lesions that would not have caused symptoms or threatened a woman's life (i.e., overdiagnosis and overtreatment), and radiation exposure (see Question 4).
- The National Cancer Institute recommends that women age 40 or older should have screening mammograms every 1 to 2 years (see Question 5).
- Women can get high-quality mammograms in breast clinics, hospital radiology departments, mobile vans, private radiology offices, and doctors' offices (see Question 12).

1. What is a mammogram?

A mammogram is an x-ray picture of the breast.

Mammograms can be used to check for breast cancer in women who have no signs or symptoms of the disease. This type of mammogram is called a screening mammogram. Screening mammograms usually involve two x-ray pictures, or images, of each breast. The x-ray images make it possible to detect tumors that cannot be felt. Screening mammograms can also find microcalcifications (tiny deposits of calcium) that sometimes indicate the presence of breast cancer.

Mammograms can also be used to check for breast cancer after a lump or other sign or symptom of the disease has been found. This type of mammogram is called a diagnostic mammogram. Signs of breast cancer may include pain, skin thickening, nipple discharge, or a change in breast size or shape; however, these signs may also be indicators of benign conditions. A diagnostic mammogram can also be used to evaluate changes found during a screening mammogram or to view breast tissue when it is difficult to obtain a screening mammogram because of special circumstances, such as the presence of breast implants (see Question 13).

2. How are *screening* and *diagnostic* mammograms different?

Diagnostic mammography takes longer than screening mammography because more x-rays are needed to obtain views of the breast from several angles. The technician may magnify a suspicious area to produce a detailed picture that can help the doctor make an accurate diagnosis.

3. What are the benefits of screening mammograms?

Early detection of breast cancer with screening mammography means that treatment can be started earlier in the course of the disease, possibly before it has spread. Results from randomized clinical



trials and other studies show that screening mammography can help reduce the number of deaths from breast cancer among women ages 40 to 74, especially for those over age 50 (1, 2). However, studies conducted to date have not shown a benefit from regular screening mammography in women under age 40 or from baseline screening mammograms (mammograms used for comparison) taken before age 40.

4. What are some of the potential harms of screening mammograms?

- **Finding cancer does not always mean saving lives**—Even though mammograms can detect malignant tumors that cannot be felt, treating a small tumor does not always mean that a woman's life will be saved. A fast-growing or aggressive cancer may have already spread to other parts of the body before it is detected. In addition, screening mammograms may not help a woman who is suffering from other, more life-threatening health conditions.
- **False-negative results**—False-negative results occur when mammograms appear normal even though breast cancer is present. Overall, screening mammograms miss up to 20 percent of breast cancers that are present at the time of screening.

The main cause of false-negative results is high breast density. Breasts contain both dense tissue (i.e., glandular tissue and connective tissue, together known as fibroglandular tissue) and fatty tissue. Fatty tissue appears dark on a mammogram, whereas dense tissue and tumors appear as white areas. Because fibroglandular tissue and tumors have similar density, tumors can be harder to detect in women with denser breasts.

False-negative results occur more often among younger women than among older women because younger women are more likely to have dense breasts. As a woman ages, her breasts usually become more fatty, and false-negative results become less likely. False-negative results can lead to delays in treatment and a false sense of security for affected women.

- **False-positive results**—False-positive results occur when radiologists decide mammograms are abnormal but no cancer is actually present. All abnormal mammograms should be followed up with additional testing (diagnostic mammograms, ultrasound, and/or biopsy) to determine whether cancer is present.

False-positive results are more common for younger women, women who have had previous breast biopsies, women with a family history of breast cancer, and women who are taking estrogen (for example, menopausal hormone therapy).

False-positive mammogram results can lead to anxiety and other forms of psychological distress in affected women. The additional testing required to rule out cancer can also be costly and time consuming and can cause physical discomfort.

- **Overdiagnosis and overtreatment**—Screening mammograms can find cancers and cases of ductal carcinoma in situ (DCIS, a noninvasive lesion in which abnormal cells that may become cancerous form in the lining of breast ducts) that need to be treated. However, they can also find cancers and cases of DCIS that will never cause symptoms or threaten a woman's life, leading to "overdiagnosis" of breast cancer. Treatment of these latter cancers and cases of DCIS is not needed, leading to "overtreatment." Overtreatment exposes women unnecessarily to the adverse effects associated with cancer therapy.

Because doctors cannot currently distinguish cancers and cases of DCIS that need to be treated from those that do not, they are all treated.

- **Radiation exposure**—Mammograms require very small doses of radiation. The risk of harm from this radiation exposure is low, but repeated x-rays have the potential to cause cancer. The benefits, however, nearly always outweigh the risk.

Women should talk with their health care providers about the need for each x-ray. In addition, they should always let their health care provider and the technician know if there is any possibility that they are pregnant.

5. What are the National Cancer Institute's (NCI) recommendations for screening mammograms?

- Women age 40 and older should have mammograms every 1 to 2 years.
- Women who are at higher than average risk of breast cancer should talk with their health care providers about whether to have mammograms before age 40 and how often to have them.

6. What factors increase a woman's risk of breast cancer?

The strongest risk factor for breast cancer is age (see Question 7). A woman's risk of developing this disease increases as she gets older. The risk of breast cancer, however, is not the same for all women in a given age group. Research has shown that women with the following risk factors have an *increased* chance of developing breast cancer:

- **Personal history of breast cancer**—Women who have had breast cancer are more likely to develop a second breast cancer.
- **Family history**—A woman's chance of developing breast cancer increases if her mother, sister, and/or daughter have been diagnosed with the disease, especially if they were diagnosed before age 50. Having a close male blood relative with breast cancer also increases a woman's risk of developing the disease.
- **Genetic alterations (changes)**—Inherited changes in certain genes (for example, *BRCA1*, *BRCA2*, and others) increase the risk of breast cancer. These changes are estimated to account for no more than 10 percent of all breast cancers. However, women who carry certain changes in these genes have a much higher risk of breast cancer than women who do not carry these changes.
- **Breast density**—Women who have a high percentage of dense breast tissue have a higher risk of breast cancer than women of similar age who have little or no dense tissue in their breasts. Some of this increase may reflect the "masking" effect of fibroglandular tissue on the ability to detect tumors on mammograms (see Question 4).
- **Certain breast changes found on biopsy**—Looking at breast tissue under a microscope allows doctors to determine whether cancer or another type of breast change is present. Most breast changes are not cancer, but some may increase the risk of developing breast cancer. Changes associated with an increased risk of breast cancer include atypical hyperplasia (a noncancerous condition in which cells have abnormal features and are increased in number), lobular carcinoma in situ (LCIS) (abnormal cells are found in the lobules of the breast), and DCIS. Because some cases of DCIS will eventually become cancer, this type of breast change is actively treated (see Question 4). Women with atypical hyperplasia or LCIS are usually monitored carefully and not actively treated. In addition, women who have had two or more breast biopsies for other noncancerous conditions also have an increased risk of developing breast cancer. This increased risk is due to the conditions that led to the biopsies and not to the biopsy procedures.
- **Reproductive and menstrual history**—Women who had their first menstrual period before age 12 or who went through menopause after age 55 are at increased risk of developing breast cancer. Women who had their first full-term pregnancy after age 30 or who have never had a full-term pregnancy are also at increased risk of breast cancer.
- **Long-term use of menopausal hormone therapy**—Women who use combined estrogen and progestin menopausal hormone therapy for more than 5 years have an increased chance of developing breast cancer.
- **Radiation therapy**—Women who had radiation therapy to the chest (including the breasts) before age 30 have an increased risk of developing breast cancer throughout their lives. This includes women treated for Hodgkin lymphoma. Studies show that the younger a woman was when she received treatment, the higher her risk of developing breast cancer later in life.
- **Alcohol**—Studies indicate that the more alcohol a woman drinks, the greater her risk of breast cancer.
- **DES (diethylstilbestrol)**—The drug DES was given to some pregnant women in the United States between 1940 and 1971 to prevent miscarriage. Women who took DES during pregnancy may have a

slightly increased risk of breast cancer. The effects of DES exposure on breast cancer risk in their daughters are unclear and still under study.

- **Body weight**—Studies have found that the chance of getting breast cancer after menopause is higher in women who are overweight or obese.
- **Physical activity level**—Women who are physically inactive throughout life may have an increased risk of breast cancer. Being active may help reduce risk by preventing weight gain and obesity.

7. What are the chances that a woman in the United States might develop breast cancer?

Age is the most important risk factor for breast cancer. The older a woman is, the greater her chance of developing the disease. Most breast cancers occur in women over the age of 50. The number of cases is especially high for women over age 60. Breast cancer is relatively uncommon in women under age 40. The NCI fact sheet *Probability of Breast Cancer in American Women* provides more information about lifetime risk. This fact sheet is available at <http://www.cancer.gov/cancertopics/factsheet/Detection/probability-breast-cancer> on the Internet.

8. What is the best method of detecting breast cancer as early as possible?

Getting a high-quality screening mammogram and having a clinical breast exam (an exam done by a health care provider) on a regular basis are the most effective ways to detect breast cancer early. As with any screening test, screening mammograms have both benefits and limitations. For example, some cancers cannot be detected by a screening mammogram but may be found by a clinical breast exam.

Checking one's own breasts for lumps or other unusual changes is called a breast self-exam, or BSE. This type of exam cannot replace regular screening mammograms or clinical breast exams. In clinical trials, BSE alone was not found to help reduce the number of deaths from breast cancer.

Although regular BSE is not specifically recommended for breast cancer screening, many women choose to examine their own breasts. Women who do so should remember that breast changes can occur because of pregnancy, aging, menopause, during menstrual cycles, or when taking birth control pills or other hormones. It is normal for breasts to feel a little lumpy and uneven. Also, it is common for breasts to be swollen and tender right before or during a menstrual period. If a woman notices any unusual changes in her breasts, she should contact her health care provider.

9. What is the Breast Imaging Reporting and Database System (BI-RADS®)?

The American College of Radiology (ACR) has established a uniform way for radiologists to describe mammogram findings. The system, called BI-RADS, includes seven standardized categories, or levels. Each BI-RADS category has a follow-up plan associated with it to help radiologists and other physicians appropriately manage a patient's care.

Breast Imaging Reporting and Database System (BI-RADS)		
Category	Assessment	Follow-up
0	Need additional imaging evaluation	Additional imaging needed before a category can be assigned
1	Negative	Continue annual screening mammograms (for women over age 40)
2	Benign (noncancerous) finding	Continue annual screening mammograms (for women over age 40)
3	Probably benign	Receive a 6-month follow-up mammogram
4	Suspicious abnormality	May require biopsy
5	Highly suggestive of malignancy (cancer)	Requires biopsy
6	Known biopsy-proven malignancy (cancer)	Biopsy confirms presence of cancer before treatment begins

Additional information about BI-RADS is available on the ACR Web site at http://www.acr.org/SecondaryMainMenuCategories/quality_safety/BIRADSAAtlas/BIRADSFAQs.aspx or by calling the ACR at 1-800-ACR-LINE (1-800-227-5463).

10. How much does a mammogram cost?

The cost of screening mammograms varies by state and by facility, and can depend on insurance coverage. However, most states have laws that require health insurance companies to reimburse all or part of the cost of screening mammograms. Women are encouraged to contact their mammography facility or their health insurance company for information about cost and coverage.

All women age 40 and older with Medicare can get a screening mammogram each year. Medicare will also pay for one baseline mammogram for female beneficiaries between the ages of 35 and 39. There is no deductible requirement for this benefit, but Medicare beneficiaries have to pay 20 percent of the Medicare-approved amount. Information about Medicare coverage is available at <http://www.medicare.gov> on the Internet, or through the Medicare Hotline at 1-800-MEDICARE (1-800-633-4227). For the hearing impaired, the telephone number is 1-877-486-2048.

11. How can uninsured or low-income women obtain a free or low-cost screening mammogram?

Some state and local health programs and employers provide mammograms free or at low cost. For example, the Centers for Disease Control and Prevention (CDC) coordinates the National Breast and Cervical Cancer Early Detection Program. This program provides screening services, including clinical breast exams and mammograms, to low-income, uninsured women throughout the United States and in several U.S. territories. Contact information for local programs is available on the CDC's Web site at <http://apps.nccd.cdc.gov/cancercontacts/nbccedp/contacts.asp> or by calling the CDC at 1-800-CDC-INFO (1-800-232-4636).

Information about low-cost or free mammography screening programs is also available through NCI's Cancer Information Service (CIS) at 1-800-4-CANCER (1-800-422-6237). Women can also check with their local hospital, health department, women's center, or other community groups to find out how to access low-cost or free mammograms.

12. Where can women get high-quality mammograms?

Women can get high-quality mammograms in breast clinics, hospital radiology departments, mobile vans, private radiology offices, and doctors' offices.

The Mammography Quality Standards Act (MQSA) is a Federal law designed to ensure that mammography is safe and reliable. Under the law, all mammography facilities operating in the United States must be certified by the Food and Drug Administration (FDA) or an FDA-approved Certifying State as meeting stringent standards. To be certified, a mammography facility must be accredited by an FDA-approved accreditation body, have mammography equipment that is tested periodically, employ trained personnel to administer tests and interpret data, and have a quality assurance program. Certified facilities must also have a system for following up on abnormal mammographic findings and for obtaining biopsy results. Facilities must be inspected annually by FDA or State inspectors who have completed appropriate training.

Women can ask their doctors or staff at the local mammography facility about FDA certification before making an appointment. All mammography facilities are required to display their FDA certificate. Women should look for the MQSA certificate at the mammography facility and check its expiration date. MQSA regulations also require that mammography facilities give patients an easy-to-read report of their mammogram results.

Information about local FDA-certified mammography facilities is available through the CIS at 1-800-4-CANCER (1-800-422-6237). Also, a searchable list of these facilities is on the FDA's Web site at <http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMQSA/mqsa.cfm> on the Internet.

13. What should women with breast implants do about screening mammograms?

Women with breast implants should continue to have mammograms. (A woman who had an implant following a mastectomy should ask her doctor whether a mammogram of the reconstructed breast is necessary.) It is important to let the mammography facility know about breast implants when scheduling a mammogram. The

technician and radiologist must be experienced in performing mammography on women who have breast implants. Implants can hide some breast tissue, making it more difficult for the radiologist to detect an abnormality on the mammogram. If the technician performing the procedure is aware that a woman has breast implants, steps can be taken to make sure that as much breast tissue as possible can be seen on the mammogram. A special technique called implant displacement views may be used.

14. What is digital mammography? How is it different from conventional (film) mammography?

Digital and conventional mammography both use x-rays to produce an image of the breast; however, in conventional mammography, the image is stored directly on film, whereas in digital mammography, an electronic image of the breast is stored as a computer file. This digital information can be enhanced, magnified, or manipulated for further evaluation more easily than information stored on film. Except for the difference in how the image is recorded and stored, there is no other difference between the two types of mammography.

Because digital mammography allows a radiologist to adjust, store, and retrieve digital images electronically, digital mammography may offer the following advantages over conventional mammography:

- Health care providers can share image files electronically, making long-distance consultations between radiologists and breast surgeons easier.
- Subtle differences between normal and abnormal tissues may be more easily noted.
- Fewer follow-up procedures may be needed.
- Fewer repeat images may be needed, reducing the exposure to radiation.

The FDA approved the use of digital mammography in January 2000. In September 2005, preliminary results from a large clinical trial that compared digital mammography with film mammography were published (3). These results showed no difference between digital and film mammograms in detecting breast cancer in the general population of women in the trial. However, the researchers concluded that digital mammography may be more accurate than conventional film mammography in women with dense breasts who are premenopausal or perimenopausal (i.e., women who had their last menstrual period within 12 months of their mammograms) or who are younger than age 50. Whether this improved accuracy will translate into a reduced risk of breast cancer death is not yet known.

Some health care providers recommend that women who have a very high risk of breast cancer, such as those with *BRCA1* or *BRCA2* gene alterations, have digital mammograms instead of conventional mammograms; however, no studies have shown that digital mammograms are superior to conventional mammograms for these women.

Digital mammography can be done only in facilities that are certified to practice conventional mammography and have received FDA approval to offer digital mammography. The procedure for having a mammogram with a digital system is the same as with conventional mammography.

15. What other technologies are being developed for breast cancer screening?

NCI is supporting the development of several new technologies to detect breast tumors. This research ranges from methods being developed in research labs to those that are being studied in clinical trials. Efforts to improve conventional mammography include digital mammography (see Question 14), magnetic resonance imaging (MRI), and positron emission tomography (PET) scanning.

16. How is NCI supporting efforts to find better ways to prevent and treat breast cancer?

NCI conducts and supports ongoing breast cancer research that ranges from basic science through the full spectrum of clinical care.

- **Basic research**—Researchers are trying to identify the causes of breast cancer, including the role of gene changes or variations in addition to changes in *BRCA1* and *BRCA2*. Scientists are also investigating how hormonal, dietary, and environmental factors might contribute to the development of breast cancer.
- **Prevention**—As a result of NCI-supported research, the drugs tamoxifen and raloxifene have been approved by the FDA to reduce the risk of developing breast cancer in women who are at high risk for the disease. Tamoxifen can be used by both premenopausal and postmenopausal women, whereas raloxifene

is appropriate for postmenopausal women only. Currently, researchers are looking for additional ways to prevent breast cancer in women who are at increased risk. They are studying other preventive agents and whether changes in diet, physical activity, nutrition, and environmental factors may lead to a reduced risk of developing breast cancer.

- **Early detection and diagnosis**—Several studies are trying to find ways to detect and diagnose breast cancer earlier in the development of the disease to improve the chance that women will receive treatment before the cancer has spread.
- **Treatment**—Numerous studies are being conducted to find more effective and less toxic treatments for breast cancer, better ways to deal with the symptoms of the disease and the side effects of its treatment, and new approaches to improve the quality of life of breast cancer patients and survivors.

On NCI's Web site (<http://www.cancer.gov/cancertopics/factsheet/Detection/mammograms>), the text below links to searches of clinical trials for female breast cancer prevention, screening, and treatment. The trials are included in NCI's list of cancer clinical trials that can also be searched at <http://www.cancer.gov/clinicaltrials/search> on the Internet.

[Current NCI-supported clinical trials for female breast cancer prevention](#)
[Current NCI-supported clinical trials for female breast cancer screening](#)
[Current NCI-supported clinical trials for female breast cancer treatment](#)

Additional information about clinical trials is available from NCI's Cancer Information Service (1-800-4-CANCER) or on the main clinical trials page of NCI's Web site at <http://www.cancer.gov/clinicaltrials> on the Internet.

Selected References

1. National Cancer Institute: Breast Cancer Screening (PDQ®)—Health Professional. Date last modified 09/03/2010. Available at: <http://www.cancer.gov/cancertopics/pdq/screening/breast/HealthProfessional>. Accessed 09/17/2010.
2. Mandelblatt JS, Cronin KA, Bailey S, et al. Effects of mammography screening under different screening schedules: Model estimates of potential benefits and harms. *Annals of Internal Medicine* 2009; 151(10): 738–747. [[PubMed Abstract](#)]
3. Pisano ED, Gatsonis C, Hendrick E, et al. Diagnostic performance of digital versus film mammography for breast cancer screening. *New England Journal of Medicine* 2005; 353(17):1773–1783. [[PubMed Abstract](#)]

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Related NCI materials and Web pages:

- National Cancer Institute Fact Sheet 5.6, *Probability of Breast Cancer in American Women* (<http://www.cancer.gov/cancertopics/factsheet/Detection/probability-breast-cancer>)
- Breast Cancer Home Page (<http://www.cancer.gov/cancertopics/types/breast>)
- *What You Need To Know About™ Breast Cancer* (<http://www.cancer.gov/cancertopics/wyntk/breast>)

How can we help?

We offer comprehensive research-based information for patients and their families, health professionals, cancer researchers, advocates, and the public.

- **Call** NCI's Cancer Information Service at 1-800-4-CANCER (1-800-422-6237)
- **Visit** us at <http://www.cancer.gov> or <http://www.cancer.gov/espanol>
- **Chat** using LiveHelp, NCI's instant messaging service, at <http://www.cancer.gov/livehelp>
- **E-mail** us at cancergovstaff@mail.nih.gov

- **Order** publications at <http://www.cancer.gov/publications> or by calling 1-800-4-CANCER
- **Get help** with quitting smoking at 1-877-44U-QUIT (1-877-448-7848)

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