Mammograms and Other Breast Imaging Tests

What is a mammogram?

A mammogram is an x-ray exam of the breast that is used to detect and evaluate breast changes.

X-rays were first used to examine breast tissue a century ago, by the German surgeon, Albert Salomon. Modern mammography has only existed since the late 1960s, when special x-ray machines were designed and used just for breast imaging. Since then, the technology has advanced, and today's mammogram is very different even from those of the 1980s and 1990s.

The x-ray machines used for mammograms today expose the breast to much less radiation than those used in the past. The x-rays do not go through tissue as easily as those used for routine chest x-rays or x-rays of the arms or legs, which also improves the image quality.

What's the difference between a screening mammogram and a diagnostic mammogram?

Screening mammograms look for signs of cancer

Screening mammograms are x-ray exams of the breasts that are used for women who have no breast symptoms or signs of breast cancer (such as a previous abnormal mammogram). The goal of a screening mammogram is to find breast cancer when it's too small to be felt by a woman or her doctor. Finding breast cancers early (before they have grown and spread) greatly improves a woman's chance for successful treatment.

A screening mammogram usually takes 2 x-ray pictures (views) of each breast. Some women, such as those with large breasts, may need to have more pictures to see as much breast tissue as possible.

Diagnostic mammograms investigate possible problems

A woman with a breast problem (for instance, a lump or nipple discharge) or an abnormal area found in a screening mammogram typically gets a diagnostic mammogram. Sometimes diagnostic mammograms are done for screening in women without breast problems who were previously treated for breast cancer.

During a diagnostic mammogram, the images are reviewed by the radiologist while you are there so that more pictures can be taken if needed to look more closely at an area of concern. In some cases, special images known as *spot views* or *magnification* views are used to make a small area of concern easier to evaluate. Other types of imaging tests such as ultrasound may also be done in addition to the mammogram, depending on the type of problem and where it is in the breast.

A diagnostic mammogram is usually interpreted in one of three ways:

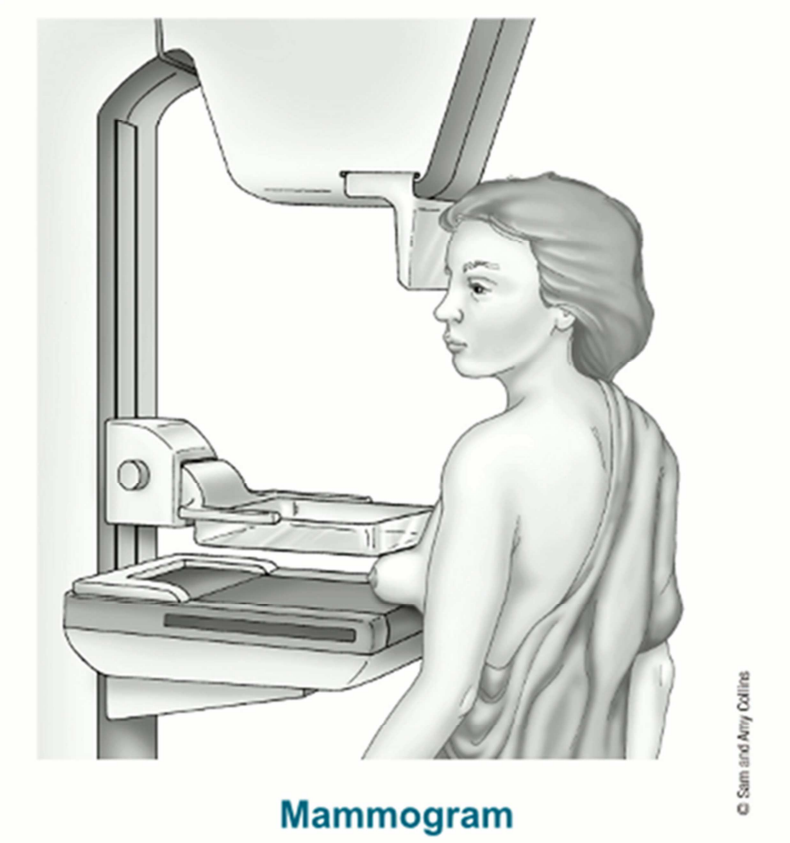
- It may reveal that an area that looked abnormal on a screening mammogram is actually normal. When this happens, the woman goes back to routine yearly screening.
- It could show that an area of concern *probably is not* cancer, but the radiologist may want to watch the area closely. When this happens it's common to ask the woman to return to be re-checked, usually in 4 to 6 months.
- The results could also suggest that a biopsy is needed to find out if the abnormal area is cancer. If your doctor recommends a biopsy, it does not mean that you have cancer.

For help with understanding your mammogram report and your radiologist's estimate of your cancer risk, see the section "Understanding your mammogram report – BI-RADS categories." If a biopsy is needed, you should discuss the different types of biopsy with your doctor to decide which type is best for you. To learn more about them, please see our document *For Women Facing a Breast Biopsy*.

How is a mammogram done?

When you have a mammogram, your breast is briefly compressed or squeezed between 2 plates attached to the mammogram machine—an adjustable plastic plate (on top) and a fixed x-ray plate (on the bottom). The bottom plate holds the x-ray film or the digital detector that records the image. The technologist compresses your breast to keep it from moving, and to make the layer of breast tissue thinner. A thinner layer of breast tissue allows the x-ray exposure to be reduced and makes the picture sharper. Although the

compression can feel uncomfortable and even painful for some women, it is needed to get a good picture and only lasts the few seconds needed to take the x-ray. Talk to the technologist if you have pain. She can reposition you to make the pressure as comfortable as possible.



The procedure produces a black and white image that is read by a radiologist (a doctor trained to interpret images from x-rays, ultrasound, magnetic resonance imaging, and related tests.)

When mammography was first developed, the image was recorded on film. More often now, the image is recorded on a computer instead. This is called a digital mammogram (also known as a *full-field digital mammogram* or FFDM). Digital mammograms may be better than film mammograms at finding cancers in women younger than 50 and in women with dense breast tissue. In the United States, most mammograms are digital.

A newer type of mammography is known as *breast tomosynthesis* or *3D mammography*. For this test, the breast is compressed once and a machine takes many low-dose x-rays as it moves over the breast in an arc. The images can then be combined by a computer into a 3-dimensional picture. This uses more radiation than most standard 2-view mammograms, but it may allow doctors to see the breast more clearly. Some studies have

suggested it might lower the chance of being called back for follow-up testing. It may also be able to find more cancers.

Not all health insurance covers tomosynthesis, so you may want to check with your insurance company if this is recommended for you.

What to expect when you have a screening mammogram

- You will have to undress above the waist to have a mammogram. The facility will give you a wrap to wear.
- A technologist will position your breasts for the mammogram. You and the technologist are the only ones in the room during the mammogram.
- To get a high-quality picture, the breast must be somewhat flattened. The technologist places the breast on the machine's plate. The plastic upper plate is lowered to compress the breast for a few seconds while the technologist takes a picture.
- The whole procedure takes about 20 minutes. The actual breast compression only lasts a few seconds.
- You may feel some discomfort when your breasts are compressed, and for some women it can be painful.
- Although usually 2 views of each breast are usually taken for a screening mammogram, for some women, such as those with breast implants or large breasts, additional pictures may be needed.
- All mammogram facilities are required to send you a summary of your results in simple language within 30 days. In most cases, you will be contacted within 5 working days if there's a possible problem seen on the mammogram.
- Only 2 to 4 screening mammograms of every 1,000 lead to a diagnosis of breast cancer.

If you are a woman age 40 or over, you should get a mammogram every year. (See our document called *Breast Cancer: Early Detection* for the American Cancer Society breast cancer screening recommendations.)

Tips for having a mammogram

These tips can help you have a good quality mammogram:

- If it's not posted, ask to see the FDA certificate that is required of all facilities that offer mammograms. The FDA ensures that each facility meets high standards of safety and quality in order to provide mammogram services.
- If you have a choice, use a facility that specializes in mammograms and does many mammograms a day.
- If you are satisfied that the facility is of high quality, continue to go there on a regular basis so that your mammograms can easily be compared from year to year.
- If you're going to a facility for the first time, bring a list of the places and dates of mammograms, biopsies, or other breast treatments you've had before.
- If you've had mammograms at another facility, try to get those mammograms to bring with you to the new facility (or have them sent there) so that they can be compared to the new ones.
- On the day of the exam, don't wear deodorant or antiperspirant. Some of these contain substances that can show up on the x-ray as white spots. If you're not returning home, you may want to take your deodorant with you to put on after your exam.
- You may find it easier to wear a skirt or pants, so that you'll only need to remove your top and bra for the mammogram.
- Schedule your mammogram when your breasts are not tender or swollen to help reduce discomfort and get a good picture. If you are still menstruating, try to avoid the week just before your period.
- Always describe any breast changes or problems you are having to the technologist doing the mammogram. Also describe any medical history that could affect your breast cancer risk—such as surgery, hormone use, or breast cancer in your family (or if you've had breast cancer before). Discuss any new findings or problems in your breasts with your doctor or nurse before having the mammogram.
- Before having any type of imaging test, tell the radiologic technologist if you are breast-feeding or if you think you might be pregnant.
- If you do not hear from your doctor within 10 days, do not assume that your mammogram was normal; call your doctor or the facility.

Where can I get help with mammogram costs?

Medicare, Medicaid, and all private health insurance policies created after March 23, 2010 cover screening mammogram costs. The new health care law requires that health insurance companies pay for screening mammograms. Insurance coverage is different for diagnostic mammograms, which usually cost more than screening mammograms.

Low-cost mammograms are available in most areas. Call the American Cancer Society at 1-800-227-2345 for information about facilities in your area.

The National Breast and Cervical Cancer Early Detection Program (NBCCEDP) also provides breast and cervical cancer early detection testing to women without health insurance for free or at very little cost. To learn more about this program, please contact the Centers for Disease Control and Prevention (CDC) at 1-800-CDC INFO (1-800-232-4636) or visit their website at www.cdc.gov/cancer.

How is mammography regulated?

In the United States, mammography is highly regulated. Although the overall quality of mammography has improved since its introduction in the late 1960s, studies done in the mid-1980s showed that quality varied greatly from place to place.

To help educate those working with mammograms, improve quality, and lower the dose of radiation, the American Cancer Society asked the American College of Radiology (ACR) to establish standards and criteria that would help women and doctors find those facilities that provided high-quality screening services. In 1986, the ACR started the first national Mammography Accreditation Program (MAP). This voluntary program raised standards nationwide and led to better mammogram services at those sites that took part in the program.

In 1992, Congress passed the Mammography Quality Standards Act (MQSA) to ensure that radiology facilities offering mammography would be required to meet minimum quality standards. Today, the US Food and Drug Administration (FDA) certifies every facility offering mammography (except those of the Department of Veterans Affairs). In order to be certified, the equipment, personnel, and practice of the facility must be reviewed by an FDA-approved accreditation body, have an on-site inspection, and meet the following criteria:

- Each mammography unit has to be accredited.
- Certain staff members must meet strict standards including:
    - Radiologists (the doctors who interpret or read the mammograms)

- Radiologic technologists (those who actually position women for the mammogram and take the pictures)

- Medical physicists (professionals who specialize in medical equipment and image production)

- Typical x-rays are reviewed for quality and information on radiation dose, which is required to be very low.

If the facility meets all of the required standards, the FDA gives its certification. These standards are outlined in the MQSA, which has been in effect since 1994. It is unlawful to do mammograms in the United States without an FDA certificate.

The FDA has a list of all of its certified mammography facilities by state and zip code. You can find those near you by visiting the FDA's website: www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMQSA/mqsa.cfm.

Reporting results

A full report of the results of your mammogram will be sent to your doctor.

The Mammography Quality Standards Act (MQSA) also requires mammography clinics notify women in writing about the results of their mammograms. Clinics must mail women an easy-to-understand summary of their mammogram results within 30 days—or "as quickly as possible" if the results suggest cancer is present. This means you could learn about the results before you doctor calls to tell you. If you want the full written mammography report in addition to the summary, you'll need to ask for it.

Radiation exposure from mammography

Modern mammography machines use low radiation doses to produce breast x-rays that are high in image quality. On average the total dose for a typical mammogram with 2 views of each breast is about 0.4 mSv (a mSv is a measure of radiation dose). Older mammography units delivered higher doses, and led to concerns about radiation risks. These older machines are no longer used.

To put dose into perspective, people in the US are normally exposed to an average of about 3 mSv of radiation each year just from their natural surroundings (this is called background radiation). The dose of radiation that a woman gets during a screening mammogram of both breasts is about the same amount of radiation she would average from her natural surroundings over about 7 weeks.

Strict guidelines ensure that mammography equipment is safe and uses the lowest dose of radiation possible. Many people are concerned about the exposure to x-rays, but the level of radiation from a mammogram today does not significantly increase the breast cancer

risk for a woman who gets regular mammograms. In theory, repeated x-rays might have the potential to cause cancer, but the benefits of mammography outweigh any possible harm from the radiation exposure.

If there is any chance you are pregnant, let your health care provider and x-ray technologist know. Although the risk to the fetus is likely to be very small, screening mammograms aren't routinely done in pregnant women.

What does the doctor look for on a mammogram?

Mammograms are read (interpreted) by radiologists – doctors that specialize in diagnosing and treating diseases and injuries using medical imaging techniques such as x-rays. When possible, the doctor reading your mammogram will compare it to your previous mammograms. This helps the doctor find small changes that could be signs of cancer.

The doctor reading your mammogram will look for different types of changes.

Calcifications

Calcifications are tiny mineral deposits within the breast tissue. They look like small white spots on a mammogram. They may or may not be caused by cancer. There are 2 types of calcifications.

Macrocalcifications

Macrocalcifications are coarse (larger) calcium deposits that are most likely due to changes in the breasts caused by aging of the breast arteries, old injuries, or inflammation. These deposits are related to non-cancerous conditions and do not require a biopsy. Macrocalcifications are found in about half the women over 50, and in 1 of 10 women under 50.

Microcalcifications

Microcalcifications are tiny specks of calcium in the breast. Microcalcifications seen on a mammogram are of more concern than macrocalcifications, but they do not always mean that cancer is present. The shape and layout of microcalcifications help the radiologist judge how likely it is that cancer is present.

In most cases, the presence of microcalcifications does not mean a biopsy is needed. But if the microcalcifications have a suspicious look and pattern, a biopsy will be recommended. (During a biopsy, the doctor removes a small piece of the suspicious area

to be looked at under a microscope. A biopsy is the only way to tell if cancer is really present.)

A mass

A mass, with or without calcifications, is another important change seen on a mammogram. Masses are areas that look abnormal and they can be many things, including cysts (non-cancerous, fluid-filled sacs) and non-cancerous solid tumors (such as fibroadenomas), but may sometimes may be a sign of cancer.

Cysts can be simple fluid-filled sacs (known as *simple cysts*) or can be partially solid (known as *complex cystic and solid masses*). Simple cysts are benign (not cancer) and don't need to be biopsied. If a mass is not a simple cyst, it is of more concern and might need to be biopsied to be sure it isn't cancer.

- A cyst and a tumor can feel the same on a physical exam. They can also look the same on a mammogram. To confirm that a mass is really a cyst, a breast ultrasound is often done. Another option is to remove (aspirate) the fluid from the cyst with a thin, hollow needle.

- If a mass is not a simple cyst (that is, if it's at least partly solid), more imaging tests may be needed. Some masses can be watched with regular mammograms or ultrasound, while others may need a biopsy. The size, shape, and margins (edges) of the mass may help the radiologist determine if cancer is likely to be present.

Having your prior mammograms available for the radiologist is very important. They can help show that a mass or calcification has not changed for many years. This would mean that it's likely not cancer and a biopsy is not needed.

Breast density

Your mammogram report will also contain an assessment of breast density. Breast density is based on how fibrous and glandular tissue tissues are distributed in your breast, vs. how much of your breast is made up fatty tissue.

Dense breasts are not abnormal, but they are linked to a higher risk of breast cancer. We know that dense breast tissue can make it harder to find cancers on a mammogram. Still experts do not agree what other tests, if any, should be done in addition to mammograms in women with dense breasts who aren't in a high-risk group (based on gene mutations, breast cancer in the family, or other factors).

Getting called back after a mammogram

Getting called back after a screening mammogram is fairly common and doesn't mean you have cancer. In fact, less than 10% of women called back for more tests are found to have breast cancer. Often, it just means more pictures or an ultrasound needs to be done to look at a suspicious area more carefully. Getting called back is more common for first mammograms (or when there is no previous mammogram to look at) and in mammograms done in women before menopause.

You could be called back because calcifications or a mass were seen. Sometimes an area just looks different than other parts of the breast. Sometimes when the area or mass is compressed more, it no longer looks suspicious. For some masses, an ultrasound shows that they are only cysts and there is no concern for cancer.

But if these follow-up tests find that the area is suspicious for cancer, a biopsy will be needed. There are several different types of biopsies, but they all involve removing a piece of tissue from the abnormal area to be looked at under the microscope. Often biopsies are done by the radiologist using imaging tests like mammography or ultrasound to be sure the right area is biopsied. Learn about the different types of biopsies and what to expect in our document *For Women Facing a Breast Biopsy*.

Understanding your mammogram report – BI-RADS categories

The American College of Radiology (ACR) came up with a standard way to describe mammogram findings and results. In this system, the results are sorted into categories numbered 0 through 6. This system is called the *Breast Imaging Reporting and Data System* (BI-RADS). Having a standard way of reporting mammogram results lets doctors use the same words and terms, which can help ensure better follow up of suspicious findings. These categories are used in the official report that goes to your doctor. Different wording is often used in the letters sent to patients. Here's a brief review of the categories:

X-ray assessment is incomplete

Category 0: Additional imaging evaluation and/or comparison to prior mammograms is needed.

This means a possible abnormality may not be clearly seen or defined and more tests are needed, such as the use of spot compression (applying compression to a smaller area when doing the mammogram), magnified views, special mammogram views, or ultrasound.

This may also suggest that the mammogram should be compared with older ones to see if there have been changes in the area over time.

X-ray assessment is complete

Category 1: Negative

There's no significant abnormality to report. The breasts look the same (they are symmetrical) with no masses (lumps), distorted structures, or suspicious calcifications. In this case, *negative* means nothing bad was found.

Category 2: Benign (non-cancerous) finding

This is also a negative mammogram result (there's no sign of cancer), but the reporting doctor chooses to describe a finding known to be benign, such as benign calcifications, lymph nodes in the breast, or calcified fibroadenomas. This ensures that others who look at the mammogram will not misinterpret the benign finding as suspicious. This finding is recorded in the mammogram report to help when comparing to future mammograms.

Category 3: Probably benign finding – Follow-up in a short time frame is suggested

The findings in this category have a very high chance (greater than 98%) of being benign (not cancer). The findings are not expected to change over time. But since it's not proven benign, it's helpful to see if the area in question does change over time.

Follow-up with repeat imaging is usually done in 6 months and regularly after that until the finding is known to be stable (usually at least 2 years). This approach helps avoid unnecessary biopsies, but if the area does change over time, it still allows for early diagnosis.

Category 4: Suspicious abnormality – Biopsy should be considered

Findings do not definitely look like cancer but could be cancer. The radiologist is concerned enough to recommend a biopsy. The findings in this category can have a wide range of suspicion levels. For this reason, some doctors divide this category further:

- 4A: finding with a low suspicion of being cancer
- 4B: finding with an intermediate suspicion of being cancer
- 4C: finding of moderate concern of being cancer, but not as high as Category 5

Not all doctors use these subcategories.

Category 5: Highly suggestive of malignancy – Appropriate action should be taken

The findings look like cancer and have a high chance (at least 95%) of being cancer. Biopsy is very strongly recommended.

Category 6: Known biopsy-proven malignancy – Appropriate action should be taken

This category is only used for findings on a mammogram that have already been shown to be cancer by a previous biopsy. Mammograms may be used in this way to see how well the cancer is responding to treatment.

BI-RADS reporting for breast density

Mammogram reports will also include an assessment of breast density. BI-RADS classifies breast density into 4 groups:

The breasts are almost entirely fatty

The breasts contain little fibrous and glandular tissue, which means the mammogram would likely detect anything abnormal.

There are scattered areas of fibroglandular density

There are a few areas of fibrous and glandular tissue in the breast.

The breasts are heterogeneously dense, which may obscure small masses

The breast has more areas of fibrous and glandular tissue that are found throughout the breast. This can make it hard to see small masses.

The breasts are extremely dense, which lowers the sensitivity of mammography

The breast has a lot of fibrous and glandular tissue. This may make it harder to find a cancer that may be present, as it can blend in with normal breast tissue.

In some states, women whose mammograms show heterogeneously dense or extremely dense breasts must be told that they have “dense breasts” in the summary of the mammogram report that is sent to patients (sometimes called the *lay summary*). The language used is mandated by law, and may say something like, “Your mammogram shows that your breast tissue is dense. Dense breast tissue is common and is not

abnormal. However, dense breast tissue can make it harder to evaluate the results of your mammogram and may also be associated with an increased risk of breast cancer. This information about the results of your mammogram is given to you to raise your awareness and to inform your conversations with your doctor. Together, you can decide which screening options are right for you. A report of your results was sent to your physician."

What are the limitations of mammograms?

As is the case with most medical tests, mammography has limitations.

Even though mammograms can detect breast cancers too small to be felt, treating a small tumor does not always mean it can be cured. A fast-growing or aggressive cancer may have already spread before it's found.

The value of a screening mammogram also depends on a woman's overall health status. Detecting breast cancer early may not help prolong the life of a woman who has other kinds of serious or life-threatening health problems such as congestive heart failure, end-stage renal disease, or chronic obstructive pulmonary (lung) disease. The American Cancer Society screening guidelines emphasize that women with serious health problems or short life expectancies should discuss with their doctors whether to continue having mammograms. Our guidelines also stress that age alone should not be the reason to stop having regular mammograms.

False-negative results

A false-negative mammogram appears normal even though breast cancer is present. Overall, screening mammograms do not find about 1 in 5 breast cancers.

False negatives occur more often among women with dense breasts. Breasts often become somewhat less dense as women age, so false negatives are more common among younger women than among older women. False-negative results can delay treatment and promote a false sense of security for the woman.

False-positive results

A false-positive mammogram looks abnormal but no cancer is actually present. Abnormal mammograms require extra testing (diagnostic mammograms, ultrasound, and sometimes MRI or even biopsy) to find out if cancer is present.

False-positive results are more common in women who are younger, have dense breasts, have had breast biopsies, have breast cancer in the family, or are taking estrogen. About half the women getting annual mammograms over a 10-year period will have a false-positive finding. The odds of a false-positive finding are highest for the first

mammogram, and are lower on subsequent mammograms. Women who have past mammograms available for comparison reduce their odds of a false-positive finding by 50%.

False-positive mammograms can cause anxiety. The extra tests needed to be sure cancer isn't there cost time and money and also cause physical discomfort.

Over-diagnosis and over-treatment

While screening mammograms can find invasive breast cancer and ductal carcinoma in situ (DCIS, cancer cells in the lining of breast ducts) that need to be treated, it's also possible that some invasive cancers and DCIS detected on mammography will not keep growing. This means that some tumors are not life-threatening, and never would have been detected if a woman had not gotten a mammogram. The problem is that doctors can't tell these cancers from those that will grow and spread.

Our only hint that over-diagnosis may exist is through statistical analysis that compares the number of cancers found by mammography over long periods of time with the numbers of cancers that would have been expected without screening. Over-diagnosis is a concern because an over-diagnosed cancer will still be treated. This means that some women are treated unnecessarily because we don't know which women fall into this group at the time the cancer is diagnosed. These cases would be considered over-treatment, which exposed the women unnecessarily to the adverse effects of cancer therapy. Because doctors often cannot be sure which cancers and cases of DCIS will become life-threatening, they are all treated. Although there is a wide range of estimates of the percentage of breast cancers that might be over-diagnosed by mammography, the most credible estimates range from 0-10%.

Mammograms after breast cancer

Mammograms after breast-conserving surgery

Today, most breast cancers can be treated without removing the entire breast. Instead, many women have breast conserving surgery (BCS), sometimes called partial mastectomy or lumpectomy. This procedure removes the cancerous tumor and some of the surrounding normal breast tissue. BCS is almost always followed by radiation treatment.

For women who have had BCS, most experts recommend having a mammogram of the treated breast 6 months after radiation treatment is finished. Radiation and surgery both cause changes in the skin and breast tissues. These changes show up on the mammogram, making it harder to read. The changes usually peak 6 months after the radiation is completed, and the mammogram done at this time serves as a new baseline for the

affected breast for that woman. Future mammograms will be compared with this one, to help the doctor follow up on healing and check for recurrence (the cancer coming back).

Depending on the results, the next exam for that breast may be 6 to 12 months later. Follow-up mammograms of the treated breast should be done at least yearly after that, but some doctors may recommend more frequent mammograms depending on the mammogram results.

The opposite (untreated) breast still needs yearly mammograms.

Mammograms after mastectomy

The different types of mastectomy, including *simple mastectomy, modified radical mastectomy, and radical mastectomy,* all involve removal of all of the breast tissue

Women who have had these surgeries to treat for breast cancer need no further routine screening mammograms of the affected side. (If both breasts are removed, they don't need mammograms at all.) Although cancer can come back in the skin or chest wall on that side, it can be found by physical exam, and there isn't enough tissue remaining after these kinds of mastectomies to do a mammogram.

Although it is possible to do a mammogram of reconstructed breasts, experts agree that women who have breast reconstruction after their breasts are fully removed (with a simple, modified radical mastectomy, or radical mastectomy) do not need routine mammograms.

One type of mastectomy that experts agree requires follow-up mammograms is the *subcutaneous mastectomy,* also called skin-sparing mastectomy. In this operation, the woman keeps her nipple and the tissue just under the skin. Often, an implant is placed under the skin during the operation. This operation leaves behind enough breast tissue to require yearly screening mammograms in these women.

Any woman who is not sure what type of mastectomy she has had or whether she needs mammograms should ask her doctor.

Mammograms of the unaffected breast are needed each year. This is very important, because women who have had one breast cancer are at higher risk of developing a new cancer in the other breast.

For women who have had breast reconstruction, a diagnostic mammogram may be done if an area of concern is found on a physical exam. Further imaging with ultrasound or MRI may also be helpful.

The American Cancer Society does not have recommendations or guidelines for mammograms or other breast imaging in women who have been treated for breast cancer.

Mammograms in special circumstances

Mammograms for younger women

Mammograms can be more difficult to read in younger women, because their breast tissue is more often dense and this can hide a tumor on an x-ray..

Screening mammograms are not recommended for average-risk women under age 40.

For some younger women who are at high risk for developing breast cancer (due to a gene mutation, a strong family history, or previous radiation to the chest for cancer), the American Cancer Society recommends screening with yearly breast MRIs and mammograms beginning at age 30 and continuing for as long as the woman is in good health. But because the evidence about the best age at which to start screening is limited, this decision should be based on discussions between patients and their health care providers, taking into account personal circumstances and preferences.

Our document called *Breast Cancer: Early Detection* gives more details about the American Cancer Society breast cancer screening recommendations. It also tells you more about figuring out your breast cancer risk.

Mammograms for women with breast implants

Women who have implants are a special challenge for mammogram screening. The x-rays used for imaging the breasts cannot go through silicone or saline implants well enough to show the breast tissue that is over or under it. This means that the part of the breast tissue covered up by the implant will not be seen on the mammogram.

In order to see as much breast tissue as possible, women with implants have 4 extra pictures (2 on each breast) as well as the 4 standard pictures taken during a screening mammogram. In these extra x-ray pictures, called *implant displacement* (ID) views, the implant is pushed back against the chest wall and the breast is pulled forward over it. This allows better imaging of the front part of each breast. Implant displacement views are more difficult (and can be less comfortable) in women who have had hard scar tissue form around the implants (*contractures*). They are easier in women whose implants are placed underneath (behind) the chest muscle.

Although these women do have more pictures taken at each mammogram, the guidelines for how often women with implants should have screening mammograms are the same as for women without them. (See *Breast Cancer: Early Detection* for the American Cancer Society's breast cancer screening guidelines.)

A ruptured (burst) implant can sometimes be diagnosed on a mammogram, but a ruptured implant will often look normal. Magnetic resonance imaging (MRI), on the other hand, is

extremely good at finding an implant rupture.. See the next section of this document for more information on MRI.

Very rarely, mammograms can cause an implant to rupture. It's important to tell the technologist before your mammogram if you have implants.

Breast MRI (magnetic resonance imaging)

MRI scans use magnets and radio waves instead of x-rays to produce very detailed, cross-sectional pictures of the body. The energy from the radio waves is absorbed and then released in a pattern formed by the type of body tissue and by certain diseases. A computer translates the pattern into a very detailed image. For most breast MRIs, a contrast material (called *gadolinium*) is injected into a vein (IV) in the arm during the exam. This improves the ability of the MRI to clearly show abnormal breast tissue.

Breast MRI is mainly used for 2 purposes:

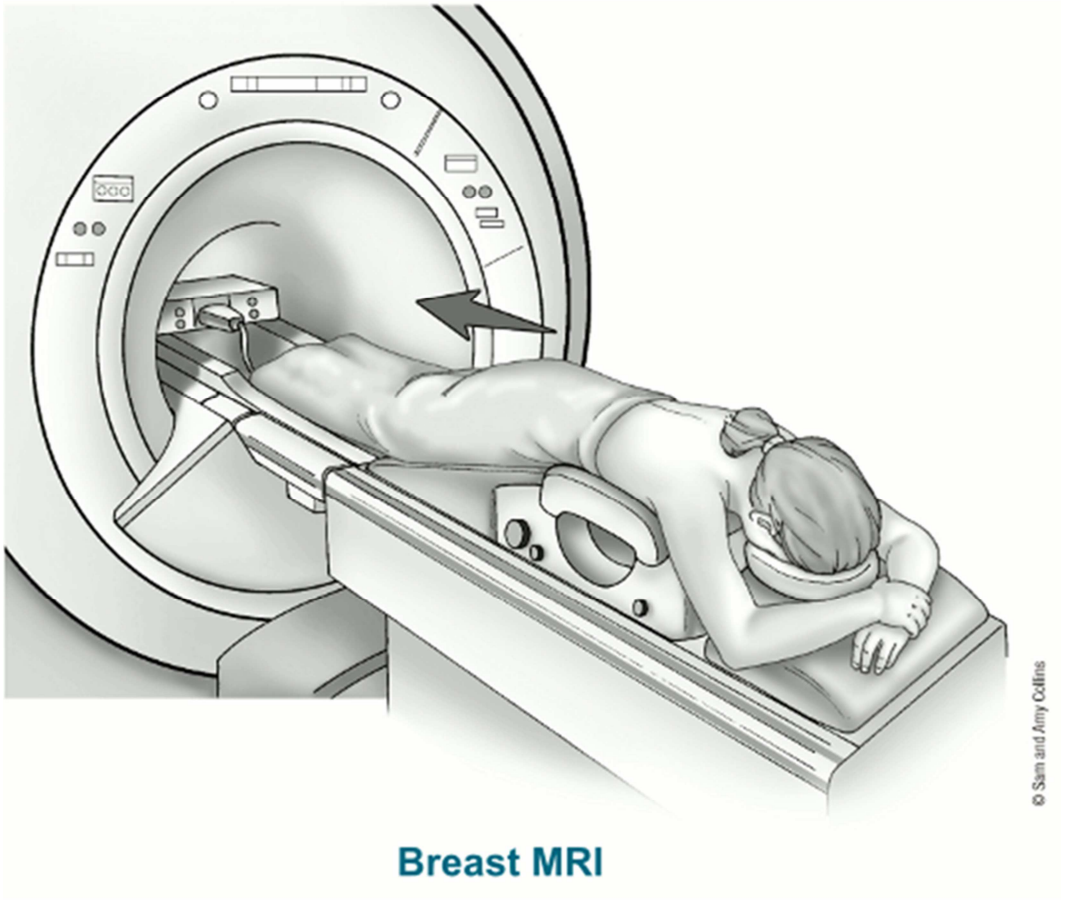
- For women who have been diagnosed with breast cancer, to help measure the size of the cancer and look for any other tumors in the breast. It also can be used to look at the opposite breast, to be sure that it doesn't contain any tumors.
- For certain women at high risk for breast cancer, screening MRI is recommended along with a yearly mammogram. MRI is not recommended as a screening tool by itself because it can miss some cancers that a mammogram would detect.

Although MRI can find some cancers not seen on than mammogram, it is also more likely to find something that turns out not to be cancer (called a false positive). False-positive findings have to be checked out to know that cancer isn't present, which means coming back for further tests and/or biopsies. This is why MRI is not recommended as a screening test for women at average risk of breast cancer, as it would result in unneeded biopsies and other tests in many of these women.

Just as mammography uses x-ray machines that are specially designed to image the breasts, breast MRI also requires special equipment. However, not all hospitals and imaging centers have dedicated breast MRI equipment available. It is also important that you have your screening MRI at a facility that can perform an MRI-guided breast biopsy. Otherwise, the entire scan will need to be repeated at another facility if a biopsy is needed.

Because breast MRI is expensive, it often needs to be approved by an insurance company before the scan is done. Most private insurance that pays for mammogram screening will probably also pay for MRI for screening tests if a woman can be shown to be at high risk. It can help to go to a center with a high-risk clinic, where the staff has experience getting approval for breast MRIs.

What to expect when you get a breast MRI



Breast MRI

When getting ready for a breast MRI, you can eat and drink as usual. You will need to take off clothes with metal parts such as zippers, snaps, or buttons, and put on a gown or top. Jewelry, hairpins, safety pins, and anything else made of metal must be removed before you go into the MRI room. The technologist will ask if you have any metal or devices in your body, such as surgical clips, staples, implanted catheters, pacemakers, defibrillators, artificial joints, metal fragments, tattoos, permanent eyeliner, body jewelry, and so on. Some metal objects will not cause problems, but others might. Tell the staff before the scan if you have any allergies, if you have breast implants or a tissue expander, or if you are pregnant or breast-feeding.

Unless your exam is being done only for implant evaluation, you will have an IV put in so you can get contrast dye to help outline the structures of the breast,.

MRI scans can take a long time—often up to an hour. For a breast MRI, you have to lie inside a narrow tube, face down, on a platform specially designed for the procedure. The platform has openings for each breast that allow them to be imaged without being

compressed. The platform contains the sensors needed to capture the MRI image. It is important to stay very still throughout the exam. .

Breast ultrasound

Ultrasound, also known as *sonography*, uses sound waves to look inside a part of the body. A gel is put on the skin of the breast and a handheld instrument called a transducer is rubbed with gel and pressed against the skin. It emits sound waves and picks up the echoes as they bounce off body tissues. The echoes are converted by a computer into a black and white image on a computer screen. This test is painless and does not expose you to radiation.

Breast ultrasound is not routinely used for screening and cannot replace mammograms. Instead, it is most often used to evaluate breast problems that are found during a screening, diagnostic mammogram, or physical exam. Although ultrasound is less sensitive than MRI (that is, it detects fewer tumors), it has become a valuable tool to use along with mammograms because it's widely available, non-invasive, and costs less than other options. But the value of an ultrasound test depends on the operator's level of skill and experience—though this is less important with the new automated ultrasound systems. Ultrasounds aren't used by themselves for screening because they can miss some cancers seen on mammograms.

Some studies have suggested that it may be helpful to use ultrasound along with a mammogram when screening high risk women with dense breast tissue (which is hard to evaluate with a mammogram). More studies are needed to figure out if ultrasound should be added to routine screening mammograms for some groups of women.

Ultrasound is useful for taking a closer look at some breast masses, and it's the only way to tell if a mass is a cyst without putting a needle into it to take out (aspirate) fluid. It may also be used to help doctors guide a biopsy needle into an area of concern in the breast. In someone with a breast tumor, it is also used to look at lymph nodes under the arm.

Newer ultrasound systems use a larger transducer that can automatically scan most or all of the breast in a short time. This is called *automated whole breast ultrasound* (AWBU). AWBU is not generally used to guide a biopsy, but is more often used for screening (in addition to another test such as a mammogram or MRI).

Other breast imaging methods

Ductogram (galactogram)

A ductogram, also called a galactogram, is sometimes used to help find the cause of any worrisome nipple discharge. In this test, a very thin metal tube is put into the opening of a

duct in the nipple that the discharge is coming from. A small amount of contrast material is put in. It outlines the shape of the duct on x-ray and can show whether there is a mass inside the duct.

Nuclear medicine studies

For nuclear medicine studies (also called nuclear scans) small amounts of radioactive substances are injected into the body and special cameras are used to see where they go. Depending on the substance used, different types of abnormalities may be found. Unlike most other imaging tests that are based on changes tumors cause in the body's structure, nuclear medicine scans depend on changes in tissue metabolism. A couple of newer subtypes of nuclear medicine studies are described below under "Other experimental breast imaging tests."

PET (positron emission tomography) scan

For a PET scan, glucose (a form of sugar) that contains a radioactive atom is injected into the bloodstream. Because cancer cells grow rapidly, they absorb large amounts of the radioactive sugar. After about an hour, a special camera is used to create a picture of areas of radioactivity in the body. Some machines are able to do both a PET and CT scan at the same time (PET/CT scan). This lets the radiologist compare areas of higher radioactivity on the PET with the detailed picture of that area on the CT.

PET scans have been studied to see if they can help distinguish between malignant or benign tumors in the breast, but they aren't accurate enough to be helpful. More often, PET/CT scans are used in patients known to have breast cancer to see if the cancer has spread.

Scintimammography (molecular breast imaging)

A radioactive tracer known as *technetium sestamibi* has been studied to help detect breast cancer. For this test, a small amount of the radioactive tracer is put into a vein. The tracer attaches to breast cancer cells and is detected by a special camera.

This test is not used as a screening test. Some radiologists believe this test may be helpful in looking at suspicious areas found by mammogram. But based on previous studies, scintimammography is not as good as MRI at finding cancers.

Current research is aimed at improving the technology and evaluating its use in specific situations, such as in women with dense breasts.

Electrical impedance imaging (T-scan™)

Electrical impedance imaging (EIT) scans the breast for electrical conductivity. It's based on the idea that breast cancer cells conduct electricity in a different way than normal cells. The test passes a very small electrical current through the breast and then detects it on the skin of the breast. This is done using small electrodes that are taped to the skin. EIT does not use radiation or compress the breasts.

This test is FDA approved as a diagnostic aid in helping classify tumors found on mammogram. But at this time it has not had enough clinical testing to be used in breast cancer screening.

Thermography (thermal imaging)

Thermography is a way to measure and map the heat on the surface of the breast using a special heat-sensing camera. It's based on the idea that the temperature rises in areas with increased blood flow and metabolism, which could be a sign of a tumor.

Thermography has been around for many years, but studies have shown that it's not an effective screening tool for finding breast cancer early. Although it has been promoted as helping detect breast cancer early, a 2012 research review found that thermography was able to detect only a quarter of the breast cancers found by mammography. In other words, it failed to detect 3 out of 4 cancers that were known to be present in the breast. Digital infrared thermal imaging (DITI), which some people believe is a newer and better type of thermography, has the same failure rate. This is why thermography should not be used as a substitute for mammograms.

Other experimental breast imaging tests

Some newer techniques are now being studied for breast imaging. These tests are in the earliest stages of research. It will take time to see if any of these imaging tests are as good as or better than those we use today.

Optical imaging tests pass light into the breast and then measure the light that returns or passes through the tissue. The technique does not use radiation and does not require breast compression. Studies going on now are looking at combining optical imaging with other tests like MRI or 3D mammography to help diagnose breast cancer.

Molecular breast imaging (MBI) is a newer nuclear medicine imaging technique for the breast. It's being studied as a way to follow up breast problems (such as a lump or an abnormal mammogram). It is also being studied in addition to mammograms for women with dense breasts.

Positron Emission Mammography (PEM) is another newly developed imaging exam of the breast. It uses sugar attached to a radioactive particle to detect cancer cells. The

PEM scanner is FDA approved. Working much like a PET scan, a PEM scan may be better able to detect small clusters of cancer cells within the breast. Right now it is being studied in women with breast cancer or other breast problems to see if it can predict which lumps are cancers.

To learn more

More information from your American Cancer Society

The following related information may also be helpful to you. Free copies of these materials may be ordered from our toll-free number, 1-800-227-2345, or you can read most of them online at www.cancer.org.

More on checking women for breast cancer

Breast Cancer Early Detection (also in Spanish)

Non-Cancerous Breast Conditions (also in Spanish)

For Women Facing a Breast Biopsy (also in Spanish)

If you or someone you love has breast cancer

After Diagnosis: A Guide for Patients and Families (also in Spanish)

Breast Cancer Detailed Guide (also in Spanish)

Breast Cancer Overview (shorter and easier to read than the Detailed Guide; also in Spanish)

Inflammatory Breast Cancer

Breast Cancer in Men Detailed Guide

Breast Cancer Dictionary (also in Spanish)

Breast Reconstruction After Mastectomy (also in Spanish)

Talking With Your Doctor (also in Spanish)

National organizations and websites*

Along with the American Cancer Society, other sources of information and support include:

Centers for Disease Control and Prevention (CDC)
National Breast and Cervical Cancer Early Detection Program (NBCCEDP)
Toll-free number: 1-800-232-4636 (1-800-CDC-INFO)
Website: www.cdc.gov/cancer/nbccedp/

To find out more about the NBCCEDP, which provides breast and cervical cancer early detection testing for women without coverage for free or at very little cost

National Cancer Institute
Toll-free number: 1-800-422-6237 (1-800-4-CANCER)
Website: www.cancer.gov

Offers current information about breast cancer screening, diagnosis, and treatment as well as information on many other types of cancer

American College of Radiology (ACR)
Toll-free number: 1-800-227-5463
Website: www.acr.org

Offers information on radiology procedures, radiation safety, FAQs. and a radiology glossary in the "Patient and Family Resources" section, as well as an "Accredited Facility Search"

**Inclusion on this list does not imply endorsement by the American Cancer Society.*

No matter who you are, we can help. Contact us anytime, day or night, for cancer-related information and support. Call us at **1-800-227-2345** or visit www.cancer.org.

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