



The American College of
Obstetricians and Gynecologists
WOMEN'S HEALTH CARE PHYSICIANS

patient education **Fact Sheet**

PFS007: Testing for Human Immunodeficiency Virus OCTOBER 2017

BRCA1 and BRCA2 Mutations

*Cancer is caused by several different factors. A few types of cancer run in families. These types are called “hereditary” or “familial” cancer. They are caused by changes in **genes** that can be passed from parent to child. Changes in genes are called **mutations**.*

***Hereditary breast and ovarian cancer (HBOC) syndrome** is an inherited increased risk of breast cancer, ovarian cancer, and other types of cancer. HBOC syndrome is linked to mutations in several genes, but the most common are called **BRCA1 and BRCA2**. Inheriting one of these mutations increases the risk of getting these types of cancer. But not all women with a mutation will develop cancer.*

Cancer and BRCA Mutations

Normal cells in the body grow, divide, and are replaced on a routine basis. Sometimes, cells divide abnormally and begin to grow out of control. These cells may form growths or tumors.

Tumors can be benign (not cancer) or malignant (cancer). Benign tumors do not spread to other body tissues. Cancer tumors can invade and destroy nearby healthy tissues and organs. Cancer cells also can spread to other parts of the body and form new cancerous areas.

Everyone has *BRCA1* and *BRCA2* genes. They are called tumor suppressor genes. They keep cells from growing too rapidly. Mutations in these genes mean they do not work properly and cells can grow out of control, which can lead to cancer.

Who Is Affected?

About 1 in 300 people carry a *BRCA1* mutation, and 1 in 800 carry a *BRCA2* mutation. Anyone can have these mutations, but they are found more often in certain ethnic groups. These groups include people of Eastern or Central European Jewish, French Canadian, and Icelandic backgrounds.

BRCA Mutations and Cancer Risk

All women are at risk of getting breast cancer or ovarian cancer. The risk of breast cancer for the average American woman is about 12% in her lifetime. Having a *BRCA* mutation greatly increases the risk. The estimated risk of breast cancer in women with a *BRCA* mutation is 45–85% by age 70 years. Women who have a *BRCA* mutation also have an increased risk of cancer of the **ovary, fallopian tube, peritoneum**, pancreas, and skin (melanoma). Men who have a *BRCA* mutation have an increased risk of cancer of the breast, prostate, and pancreas.

Testing for BRCA1 and BRCA2 Mutations

Your **obstetrician–gynecologist (ob-gyn)** or other health care professional should ask you questions about your personal and family history of breast cancer and ovarian cancer (see box “Should You Be Tested?”). If your answers to these questions suggest that you may have a *BRCA* mutation, genetic testing may be offered. Genetic testing requires a sample of blood or saliva. There are several ways that testing can be done:

- If a relative with breast cancer or ovarian cancer is available, the relative’s *BRCA* genes can be analyzed. This is the best way to figure out if a known mutation caused your relative’s cancer. If your relative carries a mutation, you can have testing

to see if you have the same mutation as your relative. This is the best way to know if you are at increased risk of cancer.

- If no relative is available, and you and your family belong to an ethnic group with high numbers of people with a specific *BRCA* mutation, you can be tested for this mutation.
- If you are not part of a high-risk ethnic group but your family history suggests there may be a hereditary mutation, another option is to have testing of your *BRCA* genes. If your family has a member with breast or ovarian cancer, it is always best to test that relative first. But if that is not possible, individual testing and counseling may be recommended.

Before you have genetic testing, a **genetic counselor** or a physician who specializes in inherited types of cancer can help you understand how the testing is done, what the results may mean, and what you may do depending on the test results. Many people are concerned about possible employment discrimination or denial of health insurance coverage based on genetic testing results. The Genetic Information Nondiscrimination Act (GINA), enacted in 2009, makes it illegal for most health insurers to require genetic testing results or use results to make decisions about coverage, rates, or preexisting conditions. Most employers are prohibited from using genetic information for hiring, firing, or making any other decisions about a person's employment.

Although *BRCA1* and *BRCA2* are the most common genes linked to HBOC, researchers now know that there are other less common gene mutations associated with hereditary cancer. If genetic testing is recommended, you may be offered testing that includes other gene mutations in addition to *BRCA1* and *BRCA2* mutations.

Understanding Test Results

A positive test result means that you have the *BRCA* mutation for which you have been tested. A negative test result can mean several things:

- When a family member with cancer gives a sample and a *BRCA* mutation is found, you can be tested for that mutation. If you have a negative test result for that specific *BRCA* mutation, you have not inherited it and your risk of cancer is the same as the general population.
- If you have a family history of cancer but no family member with cancer has given a sample, and you have a negative test result for a *BRCA* mutation, it can mean that your family has a *BRCA* mutation but that you did not inherit it. It also can mean your family carries a mutation in a gene that researchers have not yet identified.

You also can have an unclear test result. This means there is a change in a *BRCA* gene, but it is not known whether the change increases the risk of cancer. Researchers are continuing to study *BRCA* and other genes to find out how they may influence cancer risk. If you have an unclear result, a genetic counselor can explain the risk-reduction strategies that may be right for you.

What a Positive Test Result Means for You and Your Family

A positive test result for a *BRCA* mutation associated with cancer means that you have an increased risk of getting cancer. It does not mean that you will get cancer. There is no test that can tell which women with a *BRCA* mutation will develop cancer or at what age. It is important to discuss your results with your genetic counselor and learn about preventive strategies that may decrease your risk of cancer (see "Cancer Prevention if You Have a *BRCA* Mutation").

Should You Be Tested?

Genetic testing is only recommended for people with a high risk of having a *BRCA* mutation. To help determine if you should have testing, some of the questions your ob-gyn or other health care professional may ask you include the following:

- Have you had breast cancer or ovarian cancer?
- Have you had ovarian cancer and do you have a close relative (parent, sibling, child, grandparent, grandchild, uncle, aunt, nephew, niece, or first cousin) with ovarian cancer, breast cancer, or both? Remember that men also can get breast cancer.
- Have you had ovarian cancer and are you of Eastern or Central European Jewish ancestry?
- Were you diagnosed with breast cancer at age 50 years or younger and do you have a close relative with ovarian cancer or breast cancer at any age?
- Have you had breast cancer at age 40 years or younger and are you of Eastern or Central European Jewish ancestry?
- Do you have a close relative with a *BRCA1* or *BRCA2* mutation?

Your answers to these and other questions will help guide your health care professional's recommendations. It is important to remember that most cases of breast and ovarian cancer are not caused by gene mutations. If there is a low chance of finding a *BRCA* mutation, your health care professional may not recommend genetic testing.

Having a *BRCA* mutation means that you can pass the mutation to your children. Your siblings also may be at risk of having the gene mutation. You are not obligated to tell your family members, but sharing the information could be life-saving for them. With this information, your family members can decide whether to be tested and to get cancer screenings at an earlier age.

Cancer Prevention if You Have a *BRCA* Mutation

If you test positive for a *BRCA* mutation, you may discuss prevention strategies with your ob-gyn or other health care professional. Prevention includes screening tests, medications, and surgery.

Screening for Breast Cancer. Breast cancer screening for women with *BRCA* mutations is recommended. Screening may include the following tests:

- Clinical breast exam by a health care professional every 6–12 months
- Annual breast imaging starting at age 25 years. **Magnetic resonance imaging (MRI)** is recommended annually for women aged 25–29 years. Beginning at age 30 years, both breast MRI and **mammography** are recommended annually.

Screening for Ovarian Cancer. Currently there is no recommended screening test for ovarian cancer for average-risk patients. For high-risk patients, one ovarian cancer screening method that has been studied is a blood test that measures levels of a marker called **CA 125**. A marker is a substance made by cancer cells. Levels of CA 125 sometimes are increased in women with ovarian cancer. An **ultrasound exam** of the ovaries also may be recommended for women with a *BRCA* mutation. If your ob-gyn or other health care professional recommends these tests, you may begin testing between the ages of 30 years and 35 years.

It is important to know that these screening tests have a limited ability to find ovarian cancer at an earlier, more treatable stage. Test results may be normal even when cancer is present. There also is a high rate of false-positive results (a positive test result in someone who does not have ovarian cancer). Other markers in addition to CA 125 are being studied to find an accurate and reliable screening test for ovarian cancer.

Medications. The use of drugs to help reduce the risk of or delay the onset of cancer is called chemoprevention. For example, a medication called tamoxifen has been shown to reduce the risk of breast cancer in women with *BRCA2* mutations. Tamoxifen is a drug that blocks the effects of **estrogen** on cancer cells that respond to this hormone.

Tamoxifen works better in women with *BRCA2* mutations because 65–79% of breast cancer tumors in this group grow in response to estrogen. Tamoxifen does not appear to reduce breast cancer risk in women with *BRCA1* mutations because fewer cancer tumors in this group respond to estrogen.

Combined hormonal birth control pills (those that contain estrogen and **progestin**) may reduce the risk of ovarian cancer. The longer a woman takes the pill, the more the risk is reduced—for every 5 years on the pill, a woman reduces her risk by about 20%. But this benefit needs to be balanced against the risks of using the pill. The pill is safe for most women, but it is associated with a small increased risk of **deep vein thrombosis (DVT)**, heart attack, and stroke. Your ob-gyn or other health care professional can help you understand how to balance the benefits and risks of using the pill.

Surgery. Surgery is another preventive option for women with *BRCA* mutations. This type of surgery is called “risk-reducing surgery.”

Surgical removal of both breasts is called risk-reducing bilateral **mastectomy**. It can reduce the risk of breast cancer by 85–100% in women with a *BRCA* mutation. Total mastectomy, in which all breast tissue is removed, including the nipple, is the most effective risk-reducing surgery for breast cancer. Mastectomy that removes the breast tissue and leaves the nipple also can be considered and is very effective.

The removal of both ovaries and both fallopian tubes is called risk-reducing bilateral **salpingo-oophorectomy**. This procedure can greatly reduce the risk of ovarian cancer in women with a *BRCA* mutation. If it is done before **menopause**, having this surgery also can reduce the risk of breast cancer. Women with these mutations should consider this surgery between the ages of 35 years and 40 years or after they have completed childbearing. You and your health care professional can discuss the timing that’s right for you. Some women may be able to delay slightly longer.

Researchers also are studying the removal of fallopian tubes (**salpingectomy**) to prevent ovarian cancer. Some cases of ovarian cancer may start in the fallopian tubes, so removing the tubes may help prevent ovarian cancer without putting a woman into menopause. More research is needed in this area.

Keep in mind that removal of the ovaries before menopause will cause you to go through menopause immediately. Symptoms may be more severe than if you were to go through menopause naturally over several years. Menopause symptoms often can be managed with hormone therapy and other treatments. You can discuss these treatment options with your health care professional before your surgery.

If you are thinking about having preventive surgery, you and your health care professional will discuss the risks and benefits. You should consider the psychological effects as well as short- and long-term complications. Timing of surgery should be based on your cancer risk, your desire to have children, and the effect that surgery will have on your well-being.

Finding More Information

If you have a personal or family history of breast cancer or ovarian cancer, think about getting tested for *BRCA* mutations. Talk with your health care professional about screening and testing options. The following organizations offer additional information about *BRCA* mutations and cancer risk:

American Cancer Society
Genetics and Cancer
www.cancer.org/cancer/cancer-causes/genetics.html

Centers for Disease Control and Prevention
KNOW: *BRCA*
www.cdc.gov/cancer/breast/young_women/knowbrca.htm

National Cancer Institute
BRCA1 and *BRCA2*: Cancer Risk and Genetic Testing
www.cancer.gov/cancertopics/factsheet/Risk/BRCA

Glossary

BRCA1 and BRCA2: Genes that function in the control of cell growth. Changes in these genes have been linked to an increased risk of breast cancer and ovarian cancer.

CA 125: A substance in the blood that may increase in the presence of some cancerous tumors.

Deep Vein Thrombosis (DVT): A condition in which a blood clot forms in veins in the leg or other areas of the body.

Estrogen: A female hormone produced by the ovaries.

Fallopian Tube: A tube through which an egg travels from the ovary to the uterus.

Genes: Segments of DNA that contain instructions for the development of a person's physical traits and control of the processes in the body. They are the basic units of heredity and can be passed down from parent to child.

Genetic Counselor: A health care professional with special training in genetics and counseling who can provide expert advice about genetic disorders and prenatal testing.

Hereditary Breast and Ovarian Cancer (HBOC) Syndrome: An inherited susceptibility to breast cancer, ovarian cancer, and other types of cancer. Its characteristics are multiple family members with breast cancer, or ovarian cancer, or both; the presence of breast cancer and ovarian cancer in a single individual; and early age of breast cancer onset.

Magnetic Resonance Imaging (MRI): A method of viewing internal organs and structures by using a strong magnetic field and sound waves.

Mammography: An imaging technique in which X-rays of the breast are used to detect breast cancer. The image that is created is called a mammogram.

Mastectomy: Surgical removal of part or all of the breast.

Menopause: The time in a woman's life when menstruation stops; defined as the absence of menstrual periods for 1 year.

Mutations: Permanent changes in genes that can be passed from parent to child.

Obstetrician–Gynecologist (Ob-Gyn): A physician with special skills, training, and education in women's health.

Ovary: One of a pair of organs in the female reproductive system that contain the eggs released at ovulation and produce hormones.

Peritoneum: The membrane that lines the abdominal cavity and surrounds the internal organs.

Progestin: A synthetic form of progesterone that is similar to the hormone produced naturally by the body.

Salpingectomy: Removal of one or both of the fallopian tubes.

Salpingo-Oophorectomy: Removal of the ovary and fallopian tube; a bilateral salpingo-oophorectomy is removal of both ovaries and fallopian tubes.

Ultrasound Exam: A test in which sound waves are used to examine internal structures.

PFS007: Designed as an aid to patients, this document sets forth current information and opinions related to women's health. The information does not dictate an exclusive course of treatment or procedure to be followed and should not be construed as excluding other acceptable methods of practice. Variations, taking into account the needs of the individual patient, resources, and limitations unique to the institution or type of practice, may be appropriate.

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