

1. What is the prostate-specific antigen (PSA) test?

Prostate-specific antigen (PSA) is a protein produced by the cells of the prostate gland. The PSA test measures the level of PSA in the blood. The doctor takes a blood sample, and the amount of PSA is measured in a laboratory. Because PSA is produced by the body and can be used to detect disease, it is sometimes called a [biological marker](#) or [tumor marker](#).

It is normal for men to have low levels of PSA in their blood; however, prostate cancer or [benign](#) (not cancerous) conditions can increase PSA levels. As men age, both benign prostate conditions and prostate cancer become more frequent. The most common benign prostate conditions are [prostatitis](#) ([inflammation](#) of the prostate) and [benign prostatic hyperplasia](#) (BPH) (enlargement of the prostate). There is no evidence that prostatitis or BPH cause cancer, but it is possible for a man to have one or both of these conditions and to develop prostate cancer as well.

PSA levels alone do not give doctors enough information to distinguish between benign prostate conditions and cancer. However, the doctor will take the result of the PSA test into account when deciding whether to check further for signs of prostate cancer.

2. Why is the PSA test performed?

The U.S. Food and Drug Administration (FDA) has approved the PSA test along with a digital rectal exam ([DRE](#)) to help detect prostate cancer in men age 50 and older. During a DRE, a doctor inserts a gloved finger into the [rectum](#) and feels the prostate gland through the rectal wall to check for bumps or [abnormal](#) areas. Doctors often use the PSA test and DRE as prostate cancer screening tests; together, these tests can help doctors detect prostate cancer in men who have no [symptoms](#) of the disease.

The FDA has also approved the PSA test to monitor patients with a history of prostate cancer to see if the cancer has come back (recurred). An elevated PSA level in a patient with a history of prostate cancer does not always mean the cancer has come back. A man should discuss an elevated PSA level with his doctor. The doctor may recommend repeating the PSA test or performing other tests to check for evidence of [recurrence](#).

It is important to note that a man who is receiving [hormone therapy](#) for prostate cancer may have a low PSA reading during, or immediately after, treatment. The low level may not be a true measure of PSA activity in the man's body. Men receiving [hormone therapy](#) should talk with their doctor, who may advise them to wait a few months after hormone treatment before having a PSA test.

3. For whom might a PSA screening test be recommended?

Doctors' recommendations for screening vary. Some encourage yearly screening for men over age 50, and some advise men who are at a higher risk for prostate cancer to begin screening at age 40 or 45. Others caution against routine screening, while still others counsel men about the risks and benefits on an individual basis and encourage men to make personal decisions about screening. Currently, Medicare provides coverage for an annual PSA test for all men age 50 and older.

Several [risk factors](#) increase a man's chances of developing prostate cancer. These factors may be taken into consideration when a doctor recommends screening. Age is the most common risk factor, with nearly 70 percent of prostate cancer cases occurring in men age 65 and older (1). Other risk factors for prostate cancer include [family history](#), race, and possibly [diet](#). Men who have a father or brother with prostate cancer have a greater chance of developing prostate cancer. African American men have the highest rate of prostate cancer, while Asian and Native American men have the lowest rates. In addition, there is some evidence that a diet higher in fat, especially animal fat, may increase the risk of prostate cancer.

4. How are PSA test results reported?

PSA test results report the level of PSA detected in the blood. The test results are usually reported as [nanograms](#) of PSA per [milliliter](#) (ng/ml) of blood. In the past, most doctors considered PSA values below 4.0 ng/ml as normal. However, recent research found prostate cancer in men with PSA levels below 4.0 ng/ml (2). Many doctors are now using the following ranges, with some variation:

- 0 to 2.5 ng/ml is low
- 2.6 to 10 ng/ml is slightly to moderately elevated
- 10 to 19.9 ng/ml is moderately elevated
- 20 ng/ml or more is significantly elevated

There is no specific normal or abnormal PSA level. However, the higher a man's PSA level, the more likely it is that cancer is present. But because various factors can cause PSA levels to fluctuate, one abnormal PSA test does not necessarily indicate a need for other diagnostic tests. When PSA levels continue to rise over time, other tests may be needed.

5. What if the test results show an elevated PSA level?

A man should discuss elevated PSA test results with his doctor. There are many possible reasons for an elevated PSA level, including prostate cancer, benign prostate enlargement, inflammation, [infection](#), age, and race.

If no other symptoms suggest cancer, the doctor may recommend repeating DRE and PSA tests regularly to watch for any changes. If a man's PSA levels have been increasing or if a suspicious lump is detected during the DRE, the doctor may recommend other tests to determine if there is cancer or another problem in the prostate. A [urine](#) test may be used to detect a [urinary tract](#) infection or blood in the urine. The doctor may recommend [imaging](#) tests, such as [ultrasound](#) (a test in which high-frequency sound waves are used to obtain images of the [kidneys](#) and [bladder](#)), [x-rays](#), or [cystoscopy](#) (a procedure in which a doctor looks into the [urethra](#) and bladder through a thin, lighted tube). Medicine or surgery may be recommended if the problem is BPH or an infection.

If cancer is suspected, a [biopsy](#) is needed to determine if cancer is present in the prostate. During a biopsy, samples of prostate [tissue](#) are removed, usually with a needle, and viewed under a microscope. The doctor may use ultrasound to view the prostate during the biopsy, but ultrasound cannot be used alone to tell if cancer is present.

6. What are some of the limitations of the PSA test?

- **Detection does not always mean saving lives:** Even though the PSA test can detect small [tumors](#), finding a small tumor does not necessarily reduce a man's chance of dying from prostate cancer. PSA testing may identify very slow-growing tumors that are unlikely to threaten a man's life. Also, PSA testing may not help a man with a fast-growing or [aggressive](#) cancer that has already spread to other parts of his body before being detected.
- **False positive tests:** False [positive test results](#) (also called false positives) occur when the PSA level is elevated but no cancer is actually present. False positives may lead to additional medical procedures that have potential risks and significant financial costs and can create anxiety for the patient and his family. Most men with an elevated PSA test turn out *not* to have cancer; only 25 to 30 percent of men who have a biopsy due to elevated PSA levels actually have prostate cancer (3).
- **False negative tests:** False [negative test results](#) (also called false negatives) occur when the PSA level is in the normal range even though prostate cancer is actually present. Most prostate cancers are slow-growing and may exist for decades before they are large enough to cause symptoms. Subsequent PSA tests may indicate a problem before the disease progresses significantly.

7. Why is the PSA test controversial?

Using the PSA test to screen men for prostate cancer is controversial because it is not yet known if this test actually saves lives. Moreover, it is not clear if the benefits of PSA screening outweigh the risks of [follow-up](#) diagnostic tests and cancer treatments. For example, the PSA test may detect small cancers that would never become life threatening. This situation, called overdiagnosis, puts men at risk for complications from unnecessary treatment such as surgery or [radiation](#).

The procedure used to diagnose prostate cancer (prostate biopsy) may cause [side effects](#), including bleeding and infection. Prostate cancer treatment may cause [incontinence](#) (inability to control urine flow) and [erectile dysfunction](#) (erections inadequate for intercourse). For these reasons, it is important that the benefits and risks of [diagnostic procedures](#) and treatment be taken into account when considering whether to undertake prostate cancer screening.

8. What research is being done to validate and improve the PSA test?

The benefits of screening for prostate cancer are still being studied. The National Cancer Institute (NCI) is currently conducting the Prostate, [Lung](#), [Colorectal](#), and [Ovarian](#) Cancer Screening Trial, or PLCO trial, to determine if certain screening tests reduce the number of deaths from these cancers. The DRE and PSA are being studied to determine whether yearly screening to detect prostate cancer will decrease a man's chance of dying from prostate cancer. Full results from this study are expected in several years. Scientists also are researching ways to distinguish between cancerous and benign conditions, and between slow-growing cancers and fast-growing, potentially lethal cancers. Some of the methods being studied are:

- **PSA velocity:** PSA velocity is based on changes in PSA levels over time. A sharp rise in the PSA level raises the suspicion of cancer.
- **Age-adjusted PSA:** Age is an important factor in increasing PSA levels. For this reason, some doctors use age-adjusted PSA levels to determine when diagnostic tests are needed. When age-adjusted PSA levels are used, a different PSA level is defined as normal for each 10-year age group. Doctors who use this method generally suggest that men younger than age 50 should have a PSA level below 2.4 ng/ml, while a PSA level up to 6.5 ng/ml would be considered normal for men in their 70s. Doctors do not agree about the accuracy and usefulness of age-adjusted PSA levels.
- **PSA density:** PSA density considers the relationship of the PSA level to the size of the prostate. In other words, an elevated PSA might not arouse suspicion if a man has a very enlarged prostate. The use of PSA density to interpret PSA results is controversial because cancer might be overlooked in a man with an enlarged prostate.
- **Free versus attached PSA:** PSA circulates in the blood in two forms: free or attached to a protein [molecule](#). With benign prostate conditions, there is more free PSA, while cancer produces more of the attached form. Researchers are exploring different ways to measure PSA and to compare these measurements to determine if cancer is present.
- **[Alteration](#) of PSA cutoff level:** Some researchers have suggested lowering the cutoff levels that determine if a PSA measurement is normal or elevated. For example, a number of studies have used cutoff levels of 2.5 or 3.0 ng/ml (rather than 4.0 ng/ml). In such studies, PSA measurements above 2.5 or 3.0 ng/ml are considered elevated. Researchers hope that using these lower cutoff levels will increase the chance of

detecting prostate cancer; however, this method may also increase overdiagnosis and false positive test results and lead to unnecessary medical procedures.

- **Protein patterns:** Scientists are also studying a test that can rapidly analyze the patterns of various proteins in the blood. Researchers hope that this technique can determine if a biopsy is necessary when a person has a slightly elevated PSA level or an abnormal DRE.

For additional information about prostate cancer, contact the NCI's Cancer Information Service (see below).

Selected References

1. Ries LAG, Eisner MP, Kosary CL, et al. (eds). *SEER Cancer Statistics Review, 1975–2001*, National Cancer Institute. Bethesda, MD, 2004 (http://seer.cancer.gov/csr/1975_2001).
2. Thompson IM, Pauler DK, Goodman PJ, et al. Prevalence of prostate cancer among men with a prostate-specific antigen level =4.0 ng per milliliter. *The New England Journal of Medicine* 2004; 350(22):2239–2246.
3. Keetch DW, Catalona WJ, Smith DS. Serial prostatic biopsies in men with persistently elevated [serum](#) prostate specific antigen values. *The Journal of Urology* 1994; 151(6):1571–1574.