

## The Prostate-Specific Antigen (PSA) Test: Questions and Answers

### Key Points

- 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 (see Question 1).
- The U.S. Food and Drug Administration (FDA) has approved the use of the PSA test along with a digital rectal exam to help detect prostate cancer in men age 50 and older. The FDA has also approved the PSA test to monitor patients with a history of prostate cancer to see if the cancer has recurred (come back) (see Question 2).
- Doctors' recommendations for PSA screening vary (see Question 3).
- The higher a man's PSA level, the more likely it is that cancer is present, but there are other possible reasons for an elevated PSA level (see Questions 4 and 5).
- Doctors take several factors into account for men who have a rising PSA after treatment for prostate cancer (see Questions 2 and 6).
- The PSA test for screening has limitations and is still controversial (see Questions 7 and 8).

### 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 causes 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 recurred (come back). If the PSA level begins to rise, it may be the first sign of recurrence. Such a biochemical relapse typically precedes clinical relapse by months or years. However, a single elevated PSA level in a patient with a history of prostate cancer does not always mean the cancer has come back. A man who has been treated for prostate cancer 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. The doctor may look for a trend of rising PSAs over time rather than a single elevated PSA.

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 65 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. The higher a man's PSA level, the more likely it is that cancer is present. But because various factors (such as age) 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.

It should be noted that it is common for normal PSA ranges to vary somewhat from laboratory to laboratory.

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

A man should discuss elevated PSA test results with his doctor. There can be different 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 if the test results show a rising PSA level after treatment for prostate cancer?

A man should discuss rising PSA test levels with his doctor. Doctors consider a number of factors before recommending further treatment. Additional treatment based on a single PSA test result is often not recommended. Rather, a rising trend in PSA test results over a period of time combined with other findings, such as an abnormal DRE, positive prostate biopsy results, or abnormal CT (computed tomography) scan results, may lead to a recommendation for further treatment.

According to the National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines in Oncology for Prostate Cancer (3), additional treatment may be indicated based on the following PSA test results:

- For men who have been in the watchful waiting phase—PSA levels have doubled in fewer than 3 years or PSA velocity (change in PSA levels over time) is greater than 0.75 ng/mL, in addition to a prostate biopsy showing evidence of worsening cancer (3).
- For men who have had a radical prostatectomy (removal of the prostate gland)—PSA does not fall to undetectable levels after surgery or a detectable PSA (> 0.3 ng/mL) that increases on two or more subsequent measurements after having undetectable levels (3).
- For men who have had other initial therapy, such as radiation therapy and/or hormonal therapy—PSA levels have risen three consecutive times at least 3 months apart after having reached an undetectable or very low level (3).

Please note that these are general guidelines. Prostate cancer is a complex disease and many variables need to be considered by each patient and his doctor.

## 7. What are some of the limitations of the PSA test?

- **Detection does not always mean saving lives:** When used in screening, the PSA test can detect small tumors. However, 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 (4).

- **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.

## 8. Why is the PSA test controversial in screening?

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.

## 9. 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), a component of the National Institutes of Health, 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 the change in PSA levels over time. A sharp rise in the PSA level raises the suspicion of cancer and may indicate a fast growing cancer. A 2006 study found that men who had a PSA velocity above 0.35 ng/mL per year had a higher relative risk of dying from prostate cancer than men who had a PSA velocity less than 0.35 ng/mL per year (5). More studies are needed to determine if high PSA velocity more accurately detects prostate cancer early.
- **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. The free PSA test is more often used for men who have higher PSA values. Free PSA may help tell what kind of prostate problem a man has. With benign prostate conditions (such as BPH), there is more free PSA, while cancer produces more of the attached form. If a man's attached PSA is high but his free PSA is not, the presence of cancer is more likely. In this case, more testing, such as prostate biopsy, may be done. 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, Melbert D, Krapcho M, et al. *SEER Cancer Statistics Review, 1975–2004*. Bethesda, MD: National Cancer Institute, 2007.
2. Thompson IM, Pauler DK, Goodman PJ, et al. Prevalence of prostate cancer among men with a prostate-specific antigen level  $<$  or  $=$  4.0 ng per milliliter. *New England Journal of Medicine* 2004; 350(22):2239–2246.

3. National Comprehensive Cancer Network, Inc. (2007). *NCCN Clinical Practice Guidelines in Oncology: Prostate Cancer v.1.2007*. Retrieved March 23, 2007, from [http://www.nccn.org/professionals/physician\\_gls/PDF/prostate.pdf](http://www.nccn.org/professionals/physician_gls/PDF/prostate.pdf).
4. 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.
5. Carter HB, Ferrucci L, Kettermann A, et al. Detection of life-threatening prostate cancer with prostate-specific antigen velocity during a window of curability. *Journal of the National Cancer Institute* 2006; 98(21):1521–1527.

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**Related NCI materials and Web pages:**

- National Cancer Institute Fact Sheet 4.20, *Selenium and Vitamin E Cancer Prevention Trial (SELECT): Questions and Answers* (<http://www.cancer.gov/cancertopics/factsheet/Prevention/SELECT>)
- National Cancer Institute Fact Sheet 5.18, *Tumor Markers: Questions and Answers* (<http://www.cancer.gov/cancertopics/factsheet/Detection/tumor-markers>)
- National Cancer Institute Fact Sheet 5.23, *Early Prostate Cancer: Questions and Answers* (<http://www.cancer.gov/cancertopics/factsheet/Detection/early-prostate>)
- National Cancer Institute Fact sheet 5.27, *Interpreting Laboratory Test Results* (<http://www.cancer.gov/cancertopics/factsheet/Detection/laboratory-tests>)
- *Understanding Prostate Changes: A Health Guide for Men* (<http://www.cancer.gov/cancertopics/understanding-prostate-changes>)
- *What You Need To Know About™ Prostate Cancer* (<http://www.cancer.gov/cancertopics/wyntk/prostate>)
- Prostate Cancer Home Page (<http://www.cancer.gov/cancertopics/types/prostate/>)

**For more help, contact:**

**NCI's Cancer Information Service**

Telephone (toll-free): 1–800–4–CANCER (1–800–422–6237)

TTY (toll-free): 1–800–332–8615

*LiveHelp*® online chat: <https://cissecure.nci.nih.gov/livehelp/welcome.asp>

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