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PSA

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Also known as: Total PSA; Free PSA

Formal name: Prostate Specific Antigen

Related tests: [Digital Rectal Exam \(DRE\)](#); [Tumor Markers](#)



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At a Glance

Why Get Tested?

To screen men for [prostate cancer](#), to help determine the necessity for a [biopsy](#) of the prostate, to monitor the effectiveness of treatment for prostate cancer, and/or to detect recurrence of prostate cancer

When to Get Tested?

When a man has symptoms suggestive of prostate cancer such as difficult, painful, and/or frequent urination; may also be ordered during and at regular intervals after prostate cancer treatment; in [asymptomatic](#) men, after a discussion with your healthcare provider about the benefits and harms of screening and you make an informed decision to undergo screening (For specific details, see prostate cancer screening for [Adults](#) and [Adults 50 and Up](#)).

Sample Required?

A blood sample drawn from a vein in your arm

Test Preparation Needed?

Avoid ejaculation for 24 hours before sample collection as it has been associated with elevated PSA levels; the sample should also be collected prior to your health practitioner performing a [digital rectal exam \(DRE\)](#) and prior to (or several weeks after) a prostate [biopsy](#).

The Test Sample

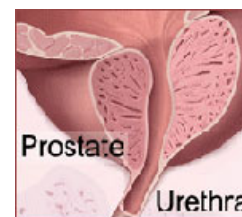
What is being tested?

Prostate specific antigen (PSA) is a [protein](#) produced primarily by cells in the prostate, a small gland that encircles the [urethra](#) in males and produces a fluid that makes up part of semen. Most of the PSA that the prostate produces is released into this fluid, but small amounts of it are also released into the bloodstream. This test measures the amount of PSA in the blood.

The PSA test is used as a [tumor marker](#) to screen for and to monitor [prostate cancer](#). It is a good tool but not a perfect one, and most experts agree that screening should be done on [asymptomatic](#) men only after thorough discussions with their healthcare providers on the benefits and risks and after informed decisions are made to undergo screening. Elevated levels of PSA are associated with prostate cancer, but they may also be seen with [prostatitis](#) and [benign prostatic hyperplasia \(BPH\)](#). PSA levels tend to increase in all men as they age, and men of African American heritage may have levels that are higher than other men, even at earlier ages.

PSA is not diagnostic of cancer. The gold standard for identifying prostate cancer is the prostate [biopsy](#), collecting small samples of prostate tissue and identifying abnormal cells under the microscope. (Read the article on [Anatomic Pathology](#) for more information on biopsies.) The total PSA test and [digital rectal exam \(DRE\)](#) are used together to help determine the need for a prostate biopsy.

The goal of screening is to detect prostate cancer while it is still confined to the prostate. Once the presence of prostate cancer is confirmed by biopsy, another decision must be made with regard to treatment. Prostate cancer is relatively common in men as they age and many, if not most, of the tumors are very slow-growing. While prostate cancer is the number two cause of death in men, the slow-growing type is an uncommon cause of death. A [pathologist](#) may be able to help differentiate between slow-growing cases and cancers that are likely to grow aggressively and spread to other parts of the body (metastasize).



[View image](#)

Over-diagnosing and over-treatment are issues with which health practitioners are currently grappling. In some cases, the treatment can be worse than the cancer, with the potential for causing significant side effects such as incontinence and [erectile dysfunction](#). The PSA test and DRE cannot, in general, predict the course of a person's disease.

PSA exists in two main forms in the blood: complexed (cPSA, bound to other proteins) and free (not bound). The most frequently used PSA test is the total PSA, which measures the sum of complexed and the free PSA in the blood.

The free PSA test is sometimes used to help to determine whether a biopsy should be done when the total PSA is only slightly elevated. PSA is an [enzyme](#) (protein that helps different chemical reactions to occur) and when it is released into the blood, some circulating proteins inactivate PSA by binding to it. Benign prostate cells in BPH tend to release PSA that is not active (and, therefore, less likely to be bound by circulating proteins) and cancerous prostate cells tend to release PSA that is already protein-bound.

Therefore, men with BPH tend to have higher levels of free PSA and men with prostate cancer tend to have lower amounts of free PSA. A relatively low level of free PSA increases the chances that a cancer is present, even if the total PSA is not significantly elevated.

How is the sample collected for testing?

A blood sample is taken by needle from a vein in the arm.

Is any test preparation needed to ensure the quality of the sample?

Ejaculation should be avoided for 24 hours before sample collection, as it has been associated with elevated PSA levels. The sample should also be collected prior to the health practitioner performing a [digital rectal exam \(DRE\)](#) and prior to (or several weeks after) a prostate [biopsy](#), as both of these can also elevate PSA levels.

The Test

How is it used?

The PSA test and [digital rectal exam \(DRE\)](#) may be used to screen both [asymptomatic](#) and symptomatic men for [prostate cancer](#). PSA is a [protein](#) produced primarily by cells in the prostate and most of the PSA is released into semen, but small amounts of it are also released into the blood. PSA exists in two forms in the blood: free (not bound) and complexed (cPSA, bound to other proteins). Lab tests can measure free PSA or total PSA (bound plus unbound).

Some organizations, such as the U.S. Preventive Services Task Force, feel that the harms associated with over-diagnosis and over-treatment outweigh the potential benefits and advise against using PSA to screen for prostate cancer in healthy men of any age. The American Cancer Society and the American Urological Association recommend that men discuss the advantages and disadvantages of PSA-based screening for prostate cancer with their healthcare provider before making an [informed decision](#) about whether to be screened or not.

While elevated PSA levels are associated with cancer, they may be caused by other conditions, such as [benign prostatic hyperplasia \(BPH\)](#) and inflammation of the prostate. An elevated PSA may be followed by a [biopsy](#), which has risk of complications such as pain, fever, blood in the urine, or urinary tract infection. (Read the article on [Anatomic Pathology](#) for more information about biopsies.)

And though prostate cancer is a relatively common type of cancer in men and the number two cause of death, many prostate cancers are slow-growing. These slow-growing types may never cause symptoms or become life-threatening. Yet prostate cancer found through screening may be treated with surgery or radiation therapy, which can have serious side effects, such as incontinence or [erectile dysfunction](#).

The total PSA test can be elevated temporarily for a variety of reasons, so if an initial PSA is elevated, another PSA may be done a few weeks after the first to determine if the PSA is still elevated. If the repeat test is elevated, a healthcare provider may recommend that series of PSAs be done over time to determine whether the level goes down, stays elevated, or continues to increase. In cases where the cancer appears to be slow-growing, the healthcare provider and patient may decide to monitor its progress rather than pursue immediate treatment (called "watchful waiting").

If the DRE is normal but the PSA is moderately elevated, a free PSA test may be used to look at the ratio of free to total PSA. This can help to distinguish between prostate cancer and other non-cancer causes of elevated PSA.

Other tests may also be recommended if either the PSA or the DRE is found to be abnormal. A [urinalysis](#) may be done, for example, to check for [urinary tract infection](#) and imaging tests, such as an ultrasound, may be done to examine the prostate.

If prostate cancer is diagnosed, the total PSA test may be used as a monitoring tool to help determine the effectiveness of treatment. It may also be ordered at regular intervals after treatment to detect recurrence of the cancer.

When is it ordered?



[View image](#)

For men who wish to be screened for **prostate cancer**, the American Cancer Society recommends that healthy men of average risk consider waiting to get tested until age 50, while the American Urological Association recommends screening for men between the ages of 55 and 69 with no routine screening after age 70.

For those at high risk, such as American men of African descent and men with a family history of the disease, the recommendation is to consider beginning testing at age 40 or 45. (See **Screening Tests for Adults (30-49): Prostate cancer** and **Screening Tests for Adults (50 and Up): Prostate cancer** for details on screening recommendations.)

The total PSA test and **digital rectal exam (DRE)** may also be ordered when a man has symptoms that could be due to prostate cancer, such as difficult, painful, and/or frequent urination, back pain, and/or pelvic pain.

If a total PSA level is elevated, a healthcare provider may order a repeat test a few weeks later to determine whether the PSA concentrations have returned to normal.

A free PSA is primarily ordered when a man has a moderately elevated total PSA. The results give the healthcare provider additional information about whether the person is at an increased risk of having prostate cancer and help with the decision of whether to **biopsy** the prostate.

The total PSA may be ordered at regular intervals during treatment of men who have been diagnosed with prostate cancer and when a man with cancer is participating in "watchful waiting" and not currently treating his prostate cancer.

What does the test result mean?

PSA test results can be interpreted a number of different ways and there may be differences in cutoff values between different laboratories.

- The value for total PSA below which the presence of **prostate cancer** is considered to be unlikely is 4.0 ng/ml (nanograms per milliliter of blood). There are some that feel that this level should be lowered to 2.5 ng/ml in order to detect more cases of prostate cancer. Others argue that this would lead to more over-diagnosing and over-treating cancers that are not clinically significant.
- There is agreement that men with a total PSA level greater than 10.0 ng/ml are at an increased risk for prostate cancer (more than a 50% chance, according to the American Cancer Society (ACS)).
- Total PSA levels between 4.0 ng/ml and 10.0 ng/ml may indicate prostate cancer (about a 25% chance, according to the ACS), **benign prostate hyperplasia (BPH)**, or inflammation of the prostate. These conditions are more common in the elderly, as is a general increase in PSA levels. Total PSA between 4.0 ng/ml and 10.0 ng/ml is often referred to as the "gray zone." It is in this range that the free PSA may be useful (see next bullet).
- Free PSA—prostate tumors typically produce mostly complexed PSA (cPSA), not free PSA. Benign prostate cells tend to produce more free PSA, which will not complex with proteins. Thus, when men in the gray zone have decreased levels of free PSA, it means that they have increased cPSA and a higher probability of prostate cancer. Conversely, when they have elevated levels of free PSA and low cPSA, the risk is diminished. The ratio of free to total PSA can help the individual and his healthcare provider decide whether or not a prostate **biopsy** should be performed.

Additional evaluations of the PSA test results are sometimes used in an effort to increase the usefulness of the total PSA as a screening tool. They include:

- PSA velocity—the change in PSA concentrations over time; if the PSA continues to rise significantly over time (at least 3 samples at least 18 months apart), then it is more likely that prostate cancer is present. If it climbs rapidly, then the affected person may have a more aggressive form of cancer.
- PSA doubling time—another version of the PSA velocity; it measures how rapidly the PSA concentration doubles.
- PSA density—a comparison of the PSA concentration and the volume of the prostate (as measured by ultrasound); if the PSA level is greater than what one would expect given the size of the prostate, the chance that a cancer is present may be higher.
- Age-specific PSA ranges—since PSA levels naturally increase as a man ages, it has been proposed that normal ranges be tailored to a man's age.

During treatment for prostate cancer, the PSA level should begin to fall. At the end of treatment, it should be at very low or undetectable levels in the blood. If concentrations do not fall to very low levels, then the treatment has not been fully effective. Following treatment, the PSA test is performed at regular intervals to monitor the person for cancer recurrence. Since even tiny increases can be significant, those affected may want to have their monitoring PSA tests done by the same laboratory each time so that testing variation is kept to a minimum.

A test called "ultrasensitive PSA" (USPSA) may be useful in monitoring for persistence or recurrence of cancer after treatment. This test detects PSA at much lower levels than the traditional test. It has been suggested that increases in PSA due to the persistence or return of cancer can be identified much sooner with this test. However, results of this test must be interpreted with caution. Because the test is very **sensitive**, there can be small increases in PSA levels from one time to the next even when no cancer is present (**false positive**).

Is there anything else I should know?

Since the **DRE** can cause a temporary elevation in PSA, the blood sample is usually collected prior to performing the DRE.

Prostate manipulation by **biopsy** or resection of the prostate will significantly elevate PSA levels. The blood test should be done before surgery or six weeks after manipulation.

Rigorous physical activity affecting the prostate, such as bicycle riding, may cause a temporary rise in PSA level. Ejaculation within 24 hours of testing can be associated with elevated PSA levels and should be avoided.

Large doses of some chemotherapeutic drugs, such as cyclophosphamide and methotrexate, may increase or decrease PSA levels.

In some men, PSA may rise temporarily due to other prostate conditions, especially infection. A study found that in about half of men with a high PSA, values later return to normal. Some authorities recommend that a high PSA should be repeated, between 6 weeks and 3 months after the high PSA, before taking any further action. Some health practitioners will prescribe a course of antibiotics if there is evidence that there is infection of the prostate.

Common Questions

1. If I have prostate cancer, what are my options?

The most common treatments include radiation, hormone therapy, and surgery. For more information, see [Prostate Cancer](#) and the links listed in the [Related Pages](#) section of this article.

2. Will PSA testing detect all prostate cancers?

No. Sometimes cancer cells do not produce much PSA and the test will be negative even when the disease is present.

3. Should every man have a PSA test?

In general, if you have symptoms that may indicate a prostate problem, then your healthcare provider will likely recommend testing. Otherwise, testing and the timing of testing are up to the individual and their healthcare provider to determine.

4. What are some other tests that may be done when the PSA level is only slightly elevated to help decide whether a prostate cancer is present?

Although PSA can help detect cancer, there are sometimes **false-positive** results, especially when the PSA is only slightly elevated. **Biopsies** used in follow-up to positive PSA results can cause discomfort, anxiety, and sometimes complications. As these tests become more widely available, they may aid some men and their healthcare providers in decisions about their future care:

- [-2] proPSA—this test looks for a **precursor** of PSA, which may be produced by prostate cancer cells at a higher rate than **benign** prostate cells. The percentage of [-2] proPSA relative to the total PSA level has been used, like the % free PSA, to help decide whether a biopsy is indicated.
- PCA3—PCA3 is a **protein** produced only in the prostate gland. The test measures the urine level of PCA3 messenger **RNA** (m-RNA), a signal from **genes** that tells the prostate to produce the PCA3 protein. Increased amounts of the m-RNA (**over-expressed**) are produced by 95% of prostate cancer cells, so an elevated level may help to indicate that a prostate cancer is present.
- *TMPRSS2-ERG* gene fusion—this test is also a urine-based assay. It detects mRNA that is the result of a gene rearrangement. The gene rearrangement is over-expressed in more than 50% of prostate cancers, so an elevated level may help to indicate that a prostate cancer is present.

These tests do not provide a definitive answer as to whether a man has a prostate cancer or not. A positive biopsy remains the gold standard in diagnosing prostate cancer. Rather, they are intended to help predict whether a biopsy would be useful in helping to establish a diagnosis.

5. What are some tests that may be done to help decide whether a prostate cancer is likely to be fast-growing and spread (metastasize) and therefore should be removed rather than watched?

- Gleason scoring—this refers to a part of the **pathologist's** report after reviewing the **biopsy** of the prostate that describes the degree to which certain features of prostate cancer known to be associated with a poor **prognosis** are present in the patient's cancer.
- Prostate gene expression profile—this is a test in which the prostate cancer in the biopsy is analyzed using genetic techniques to determine the degree of activation of certain **genes** known to be associated with poor prognosis.
- *TMPRSS2-ERG* gene fusion—this urine test, sometimes used to help determine if a biopsy is needed, has also been shown to help predict how the cancer will behave.

Although Gleason scoring is performed on all new prostate cancers discovered by biopsy, the other tests are still undergoing study. It is fair to say that there is no easy way to determine whether a prostate cancer will spread and grow quickly or will be a slow-growing cancer unlikely to cause the person's death. This makes the decision to undergo PSA testing and, if PSA is elevated, prostate biopsy, an important one.

Related Pages

On This Site

Conditions: [Prostate Cancer](#), [Benign Prostatic Hypertrophy](#)
 Screening: [Prostate Cancer - Adults \(30-49\)](#), [Prostate Cancer - Adults 50 and Up](#)
 Features: [Making Informed Decisions for Better Health](#); [Anatomic Pathology](#)
 In the News: [Prostate Cancer Screening: Medical Groups Review, Modify Guidelines](#) (2013)

Elsewhere On The Web

[National Cancer Institute: What You Need to Know about Prostate Cancer](#)
[National Cancer Institute: Fact Sheet, Prostate-Specific Antigen \(PSA\) Test](#)
[American Cancer Society: Detailed Guide, Prostate Cancer.](#)
[Centers for Disease Control and Prevention: Prostate Cancer](#)
[Prostate Cancer Research Institute](#)
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