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## About Prostate Cancer

### Overview

If you have been diagnosed with prostate cancer or are worried about it, you likely have a lot of questions. Learning some basics is a good place to start.

- [What Is Prostate Cancer?](#)

### Research and Statistics

See the latest estimates for new cases of prostate cancer and deaths in the US and what research is currently being done.

- [Key Statistics for Prostate Cancer](#)
- [What's New in Prostate Cancer Research?](#)

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## What Is Prostate Cancer?

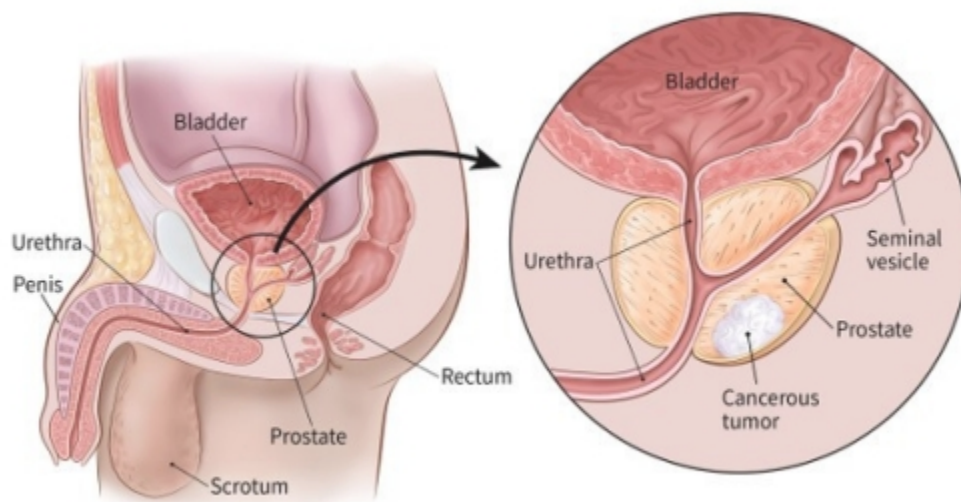
Cancer starts when cells in the body begin to grow out of control. Cells in nearly any part of the body can become cancer cells, and can spread to other areas of the body. To learn more about how cancers start and spread, see [What Is Cancer?](#)<sup>1</sup>

Prostate cancer begins when cells in the prostate gland start to grow uncontrollably. The prostate is a gland found only in males. It makes some of the fluid that is part of

semen.

The prostate is below the bladder and in front of the rectum. The size of the prostate changes with age. In younger men, it is about the size of a walnut, but it can be much larger in older men.

Just behind the prostate are glands called *seminal vesicles* that make most of the fluid for semen. The *urethra*, which is the tube that carries urine and semen out of the body through the penis, goes through the center of the prostate.



## Types of prostate cancer

Almost all prostate cancers are **adenocarcinomas**. These cancers develop from the gland cells (the cells that make the prostate fluid that is added to the semen).

Other types of prostate cancer include:

- Sarcomas
- Small cell carcinomas
- Neuroendocrine tumors (other than small cell carcinomas)
- Transitional cell carcinomas

These other types of prostate cancer are rare. If you have prostate cancer it is almost certain to be an adenocarcinoma.

Some prostate cancers can grow and spread quickly, but most grow slowly. In fact, autopsy studies show that many older men (and even some younger men) who died of

other causes also had prostate cancer that never affected them during their lives. In many cases neither they nor their doctors even knew they had it.

## Possible pre-cancerous conditions of the prostate

Some research suggests that prostate cancer starts out as a pre-cancerous condition, although this is not yet known for sure. These conditions are sometimes found when a man has a [prostate biopsy](#)<sup>2</sup> (removal of small pieces of the prostate to look for cancer).

### Prostatic intraepithelial neoplasia (PIN)

In PIN, there are changes in how the prostate gland cells look under a microscope, but the abnormal cells don't look like they are growing into other parts of the prostate (like cancer cells would). Based on how abnormal the patterns of cells look, they are classified as:

- **Low-grade PIN:** the patterns of prostate cells appear almost normal
- **High-grade PIN:** the patterns of cells look more abnormal

PIN begins to appear in the prostates of some men as early as in their 20s.

Many men begin to develop low-grade PIN when they are younger but don't necessarily develop prostate cancer. The possible link between low-grade PIN and prostate cancer is still unclear.

If high-grade PIN is found in your prostate biopsy sample, there is about a 20% chance that you also have cancer in another area of your prostate.

### Proliferative inflammatory atrophy (PIA)

In PIA, the prostate cells look smaller than normal, and there are signs of inflammation in the area. PIA is not cancer, but researchers believe that PIA may sometimes lead to high-grade PIN, or perhaps to prostate cancer directly.

## Hyperlinks

1. [www.cancer.org/cancer/cancer-basics/what-is-cancer.html](http://www.cancer.org/cancer/cancer-basics/what-is-cancer.html)
2. [www.cancer.org/cancer/prostate-cancer/detection-diagnosis-staging/how-diagnosed.html](http://www.cancer.org/cancer/prostate-cancer/detection-diagnosis-staging/how-diagnosed.html)

## References

See all references for Prostate Cancer ([www.cancer.org/cancer/prostate-cancer/references.html](http://www.cancer.org/cancer/prostate-cancer/references.html))

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# Key Statistics for Prostate Cancer

## How common is prostate cancer?

Other than skin cancer, prostate cancer is the most common cancer in American men. The American Cancer Society's estimates for prostate cancer in the United States for 2019 are:

- About 174,650 new cases of prostate cancer
- About 31,620 deaths from prostate cancer

## Risk of prostate cancer

About 1 man in 9 will be diagnosed with prostate cancer during his lifetime.

Prostate cancer develops mainly in older men and in African-American men. About 6 cases in 10 are diagnosed in men aged 65 or older, and it is rare before age 40. The average age at the time of diagnosis is about 66.

## Deaths from prostate cancer

Prostate cancer is the second leading cause of cancer death in American men, behind lung cancer. About 1 man in 41 will die of prostate cancer.

Prostate cancer can be a serious disease, but most men diagnosed with prostate

cancer do not die from it. In fact, more than 2.9 million men in the United States who have been diagnosed with prostate cancer at some point are still alive today.

For statistics related to survival, see [Survival Rates for Prostate Cancer](#)<sup>1</sup>.

Visit our [Cancer Statistics Center](#)<sup>2</sup> for more key statistics.

## Hyperlinks

1. [www.cancer.org/cancer/prostate-cancer/detection-diagnosis-staging/survival-rates.html](http://www.cancer.org/cancer/prostate-cancer/detection-diagnosis-staging/survival-rates.html)
2. <https://cancerstatisticscenter.cancer.org/>

## References

See all references for Prostate Cancer ([www.cancer.org/cancer/prostate-cancer/references.html](http://www.cancer.org/cancer/prostate-cancer/references.html))

American Cancer Society. *Facts & Figures 2019*. American Cancer Society. Atlanta, Ga. 2019.

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# What's New in Prostate Cancer Research?

Research into the causes, prevention, detection, and treatment of prostate is ongoing in many medical centers throughout the world.

## Genetics

New research on [gene changes](#)<sup>1</sup> linked to prostate cancer is helping scientists better understand how prostate cancer develops. This could make it possible to design medicines to target those changes. Tests to find abnormal prostate cancer genes could

also help identify men at high risk who might benefit from screening or from chemoprevention trials, which use drugs to try to keep them from getting cancer.

Most of the gene mutations that have been studied as factors that might increase prostate cancer risk are from chromosomes that are inherited from both parents. Some research has found that a certain variant of mitochondrial DNA, which is inherited only from a person's mother, might also raise a man's risk of developing prostate cancer.

## Prevention

Researchers continue to look for foods (or substances in them) that can help lower prostate cancer risk. Scientists have found some substances in tomatoes (lycopenes) and soybeans (isoflavones) that might help prevent prostate cancer. Studies are now looking at the possible effects of these compounds more closely.

Scientists are also trying to develop related compounds that are even more potent and might be used as dietary supplements. So far, most research suggests that a balanced diet including these foods as well as other fruits and vegetables is probably of greater benefit than taking these substances as dietary supplements.

One vitamin that may be important in prevention is vitamin D. Some studies have found that men with high levels of vitamin D seem to have a lower risk of developing the more lethal forms of prostate cancer. Overall though, studies have not found that vitamin D protects against prostate cancer.

Many people assume that vitamins and other natural substances are safe to take, but recent research has shown that high doses of some may be harmful, including those in supplements marketed specifically for prostate cancer. For example, one study found that men who take more than 7 multivitamin tablets per week may have an increased risk of developing advanced prostate cancer. Another study showed a higher risk of prostate cancer in men who had high blood levels of omega-3 fatty acids. Fish oil capsules, which some people take to help with their heart, contain large amounts of omega-3 fatty acids.

Some research has suggested that men who take a daily aspirin for a long time might have a lower risk of getting and dying from prostate cancer. Still, more research is needed to confirm this, and to confirm that any benefit outweighs potential risks, such as bleeding.

Scientists have also tested certain hormonal medicines called *5-alpha reductase inhibitors* as a way of reducing prostate cancer risk. The results of these studies are

discussed in [Prostate Cancer Prevention and Early Detection](#)<sup>2</sup>.

## Early detection

Doctors agree that the [prostate-specific antigen \(PSA\) blood test](#)<sup>3</sup> is not a perfect test for finding prostate cancer early. It misses some cancers, and in other cases the PSA level is high even when prostate cancer can't be found. Researchers are working on strategies to address this problem.

One approach is to try to improve on the test that measures the total PSA level, as described in [Prostate Cancer Prevention and Early Detection](#)<sup>4</sup>.

Another approach is to develop new tests based on other forms of PSA, or other tumor markers. Several newer tests seem to be more accurate than the PSA test, including:

- The **phi**, which combines the results of total PSA, free PSA, and proPSA to help determine how likely it is that a man has prostate cancer that might need treatment
- The **4Kscore test**, which combines the results of total PSA, free PSA, intact PSA, and human kallikrein 2 (hK2), along with some other factors, to help determine how likely a man is to have prostate cancer that might need treatment
- Tests such as Progenesa that look at the level of **prostate cancer antigen 3 (PCA3)** in the urine after a digital rectal exam (DRE). (The DRE pushes some of the prostate cells into the urine.) The higher the level, the more likely that prostate cancer is present.
- Tests that look for an abnormal gene change called **TMPRSS2:ERG** in prostate cells in urine collected after a DRE. This gene change is found in some prostate cancers, but it is rarely found in the cells of men without prostate cancer.
- **ConfirmMDx**, which is a test that looks at certain genes in the cells from a prostate biopsy sample

These tests aren't likely to replace the PSA test any time soon, but they might be helpful in certain situations. For example, some of these tests might be useful in men with a slightly elevated PSA, to help determine whether they should have a [prostate biopsy](#)<sup>5</sup>. Some of these tests might be more helpful in determining if men who have already had a prostate biopsy that didn't find cancer should have another biopsy. Doctors and researchers are trying to determine the best way to use each of these tests.

## Diagnosis

Doctors doing prostate biopsies often rely on transrectal [ultrasound](#)<sup>6</sup> (TRUS), which creates black and white images of the prostate using sound waves, to know where to take samples from. But standard ultrasound may not detect some areas containing cancer.

A newer approach is to measure blood flow within the gland using a technique called *color Doppler ultrasound*. (Tumors often have more blood vessels around them than normal tissue.) It may make prostate biopsies more accurate by helping to ensure the right part of the gland is sampled.

An even newer technique may enhance color Doppler further. In this approach, the patient is first injected with a contrast agent containing microbubbles, which helps improve the ultrasound images. Promising results have been reported, but more studies will be needed before its use becomes common.

Doctors are also studying whether MRI can be combined with TRUS to help guide prostate biopsies in men who previously had negative TRUS-guided biopsies but when the doctor still suspects cancer.

## Staging

Determining the [stage \(extent\) of prostate cancer](#)<sup>7</sup> plays a key role in determining a man's treatment options. But imaging tests for prostate cancer such as [CT](#)<sup>8</sup> and [MRI](#)<sup>9</sup> scans can't detect all areas of cancer, especially small areas of cancer in lymph nodes.

A newer method known as **multiparametric MRI** can be used to help determine the extent of the cancer and how aggressive it might be, which might affect a man's treatment options. This test involves getting a standard MRI, and then getting at least one other type of MRI (such as diffusion weighted imaging [DWI], dynamic contrast enhanced [DCE] MRI, or MR spectroscopy). The results of the different scans are then taken into account.

Another newer method, called **enhanced MRI**, may help find lymph nodes that contain cancer cells. Patients first have a standard MRI. They are then injected with tiny magnetic particles and have another scan the next day. Differences between the 2 scans point to possible cancer cells in the lymph nodes. Early results of this technique are promising, but it needs more research before it becomes widely used.

A newer type of [positron-emission tomography \(PET\)](#)<sup>10</sup> scan that uses radioactive carbon acetate instead of labeled glucose (sugar) may also be helpful in detecting prostate cancer in different parts of the body, as well as helping to determine if



treatment is working. This technique is now being studied.

## Treatment

Newer treatments are being developed, and improvements are being made among many standard prostate cancer treatment methods.

### Surgery

Doctors are constantly improving the surgical techniques used to treat prostate cancer. The goal is to remove all of the cancer while lowering the risk of complications and side effects from the surgery.

### Radiation therapy

As described in [Radiation Therapy for Prostate Cancer](#)<sup>11</sup>, advances in technology are making it possible to aim radiation more precisely than in the past. Current methods such as conformal radiation therapy (CRT), intensity modulated radiation therapy (IMRT), and proton beam radiation help doctors avoid giving radiation to normal tissues as much as possible. These methods are expected to increase the effectiveness of radiation therapy while reducing the side effects.

Technology is making other forms of radiation therapy more effective as well. New computer programs allow doctors to better plan the radiation doses and approaches for both external radiation therapy and brachytherapy. Planning for brachytherapy can now even be done during the procedure (intraoperatively).

### Newer treatments for early stage cancers

Researchers are looking at newer forms of treatment for early-stage prostate cancer. These new treatments could be used either as the first type of treatment or after radiation therapy in cases where it was not successful.

One treatment, known as **high-intensity focused ultrasound (HIFU)**, destroys cancer cells by heating them with highly focused ultrasonic beams. This treatment has been used in some countries for a while, but it has just recently become available in the United States. Its safety and effectiveness are now being determined.

### Nutrition and lifestyle changes

Many studies have looked at the possible benefits of specific nutrients (often as supplements) in helping to treat prostate cancer, although most of this research is still ongoing. Some compounds being studied include extracts from pomegranate, green tea, broccoli, turmeric, flaxseed, and soy.

Some early research has found that in men with a rising PSA level after surgery or radiation therapy, drinking pomegranate juice or taking a pomegranate extract may slow the time it takes for the PSA level to double. Larger studies are now looking for possible effects of pomegranate juices and extracts on prostate cancer growth.

Some encouraging early results have also been reported with flaxseed supplements. One small study in men with early prostate cancer found that daily flaxseed seemed to slow the rate at which prostate cancer cells multiplied. More research is needed to confirm this finding.

A recent study showed that taking soy supplements after surgery (radical prostatectomy) for prostate cancer did not lower the risk of the cancer coming back.

One study has found that men who choose not to have treatment for their localized prostate cancer may be able to slow its growth with intensive lifestyle changes. The men in the study ate a vegan diet (no meat, fish, eggs, or dairy products) and exercised frequently. They also took part in support groups and yoga. After one year the men saw, on average, a slight drop in their PSA level. It isn't known if this effect will last since the report only followed the men for 1 year. The regimen may also be hard for some men to follow.

## **Hormone therapy**

Several newer forms of hormone therapy have been developed in recent years. Some of these may be helpful even if standard forms of hormone therapy are no longer working.

Some examples include abiraterone (Zytiga) and enzalutamide (Xtandi), which are described in [Hormone Therapy for Prostate Cancer](#)<sup>12</sup>. Others are now being studied as well.

5-alpha reductase inhibitors, such as finasteride (Proscar) and dutasteride (Avodart), are drugs that block the conversion of testosterone to the more active dihydrotestosterone (DHT). These drugs are being studied to treat prostate cancer, either to supplement active surveillance or if the PSA level rises after prostatectomy.

## Chemotherapy

Studies in recent years have shown that many chemotherapy drugs can affect prostate cancer. Some, such as docetaxel (Taxotere) and cabazitaxel (Jevtana) have been shown to help men live longer.

Results from recent large studies have found that in men with metastatic prostate cancer, giving chemotherapy (docetaxel) earlier in the course of the disease might help them live longer. These results are encouraging, but these studies were done before newer forms of hormone therapy (abiraterone and enzalutamide) became available, so it's not clear if the results would be the same today.

Other new chemo drugs and combinations of drugs are being studied as well.

## Immunotherapy

The goal of immunotherapy is to boost the body's immune system to help fight off or destroy cancer cells.

## Vaccines

Unlike vaccines against infections like measles or mumps, prostate cancer vaccines are designed to help treat, not prevent, prostate cancer. One possible advantage of these types of treatments is that they seem to have very limited side effects. An example of this type of vaccine is sipuleucel-T (Provenge), which has received FDA approval (described in [Vaccine Treatment for Prostate Cancer](#)<sup>13</sup>).

Several other types of vaccines to treat prostate cancer are being tested in clinical trials.

One example is PROSTVAC, which uses a virus that has been genetically modified to contain prostate-specific antigen (PSA). The patient's immune system should respond to the virus and begin to recognize and destroy cancer cells containing PSA. Early results with this vaccine have been promising, and a larger study is now under way.

## Immune checkpoint inhibitors

An important part of the immune system is its ability to keep itself from attacking other normal cells in the body. To do this, it uses "checkpoints" – molecules on immune cells that need to be turned on (or off) to start an immune response. Cancer cells sometimes use these checkpoints to avoid being attacked by the immune system. But newer drugs that target these checkpoints hold a lot of promise as cancer treatments.

For example, newer drugs such as pembrolizumab (Keytruda) and nivolumab (Opdivo) target the immune checkpoint protein PD-1. In some other cancers, these types of drugs have been shown to shrink a larger portion of tumors. Studies are now being done to see how well they might work against prostate cancer.

Another example is the drug ipilimumab (Yervoy), which targets a checkpoint protein called *CTLA-4* on certain immune cells. This drug is already used to treat some other cancers, and is now being tested in men with advanced prostate cancer.

One promising approach for the future might be to combine a checkpoint inhibitor with a prostate cancer vaccine. This might strengthen the immune response and help the vaccine work better.

### Targeted therapy drugs

Newer drugs are being developed that target specific parts of cancer cells or their surrounding environments. Each type of targeted therapy works differently, but all alter the way a cancer cell grows, divides, repairs itself, or interacts with other cells.

For example, drugs called *angiogenesis inhibitors* target the growth of new blood vessels (angiogenesis) that tumors need to grow. Several angiogenesis inhibitors are being tested in clinical trials.

### Treating cancer that has spread to the bones

Doctors are studying the use of radiofrequency ablation (RFA) to help control pain in men whose prostate cancer has spread to one or more areas in the bones. During RFA, the doctor uses a CT scan or ultrasound to guide a small metal probe into the area of the tumor. A high-frequency current is passed through the probe to heat and destroy the tumor. RFA has been used for many years to treat tumors in other organs such as the liver, but its use in treating bone pain is still fairly new. Still, early results are promising.

### Hyperlinks

1. [www.cancer.org/cancer/cancer-causes/genetics.html](http://www.cancer.org/cancer/cancer-causes/genetics.html)
2. [www.cancer.org/cancer/prostate-cancer/early-detection.html](http://www.cancer.org/cancer/prostate-cancer/early-detection.html)
3. [www.cancer.org/cancer/prostate-cancer/early-detection/tests.html](http://www.cancer.org/cancer/prostate-cancer/early-detection/tests.html)
4. [www.cancer.org/cancer/prostate-cancer/early-detection.html](http://www.cancer.org/cancer/prostate-cancer/early-detection.html)
5. [www.cancer.org/cancer/prostate-cancer/early-detection/tests.html](http://www.cancer.org/cancer/prostate-cancer/early-detection/tests.html)
6. [www.cancer.org/treatment/understanding-your-diagnosis/tests/ultrasound-for-](http://www.cancer.org/treatment/understanding-your-diagnosis/tests/ultrasound-for-)

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7. [www.cancer.org/cancer/prostate-cancer/detection-diagnosis-staging/staging.html](http://www.cancer.org/cancer/prostate-cancer/detection-diagnosis-staging/staging.html)
  8. [www.cancer.org/treatment/understanding-your-diagnosis/tests/ct-scan-for-cancer.html](http://www.cancer.org/treatment/understanding-your-diagnosis/tests/ct-scan-for-cancer.html)
  9. [www.cancer.org/treatment/understanding-your-diagnosis/tests/mri-for-cancer.html](http://www.cancer.org/treatment/understanding-your-diagnosis/tests/mri-for-cancer.html)
  10. [www.cancer.org/treatment/understanding-your-diagnosis/tests/nuclear-medicine-scans-for-cancer.html](http://www.cancer.org/treatment/understanding-your-diagnosis/tests/nuclear-medicine-scans-for-cancer.html)
  11. [www.cancer.org/cancer/prostate-cancer/treating/radiation-therapy.html](http://www.cancer.org/cancer/prostate-cancer/treating/radiation-therapy.html)
  12. [www.cancer.org/cancer/prostate-cancer/treating/hormone-therapy.html](http://www.cancer.org/cancer/prostate-cancer/treating/hormone-therapy.html)
  13. [www.cancer.org/cancer/prostate-cancer/treating/vaccine-treatment.html](http://www.cancer.org/cancer/prostate-cancer/treating/vaccine-treatment.html)

## References

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