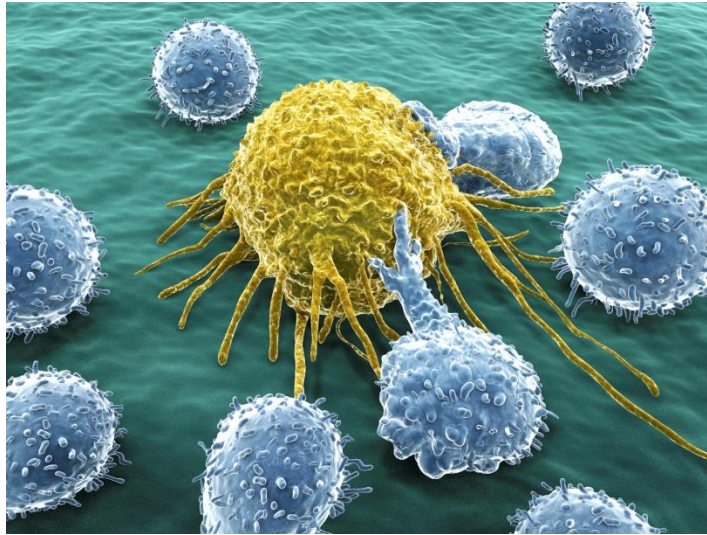


# Chapter 6: Cancer



(Migrating Cancer Cell (yellow) attacked by immune cells.)

## KEY CONCEPTS

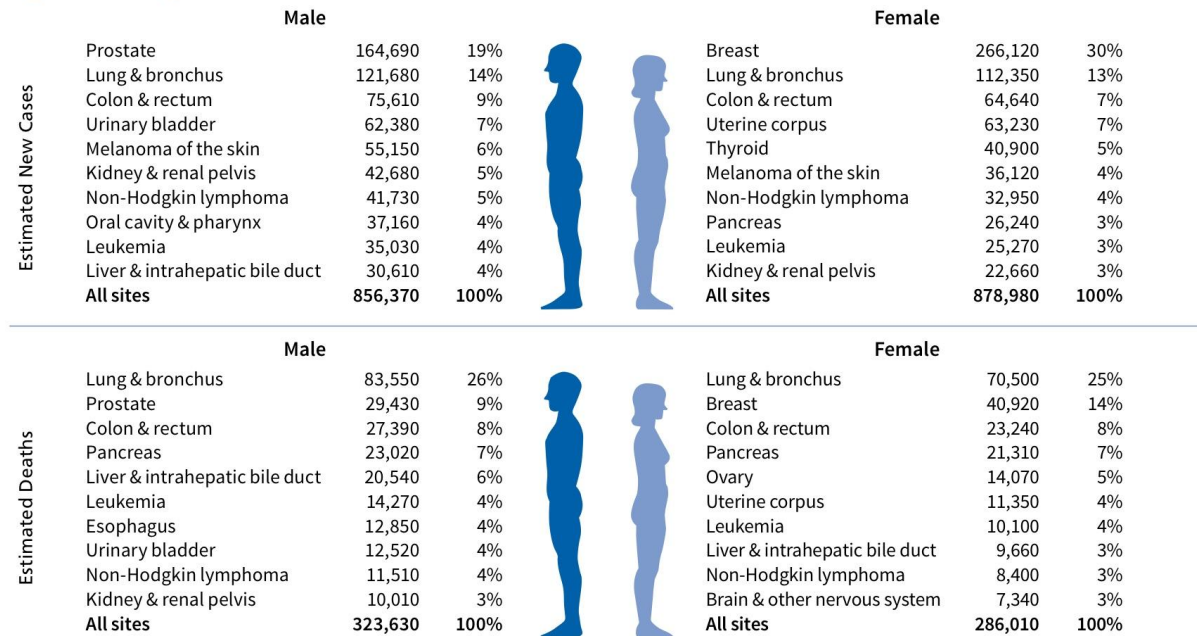
<b>Cancer</b>	<b>Genetic Mutations</b>	<b>Tumor</b>	<b>Benign</b>
<b>Malignant</b>	<b>Metastasis</b>	<b>Stages of Cancer</b>	<b>Causes of Mutations</b>
<b>Forms of Cancer</b>	<b>Cancer Statistics</b>	<b>Treatment</b>	<b>Prevention</b>

## 6.1 WHAT IS CANCER?

Cancer is currently the second leading cause of death among adults in the United States. According to the American Cancer Society, there will be over 1.7 million new cases in 2018 with over 600,000 deaths caused by cancer. Lung cancer deaths are the most reported with an average estimate of over 150,000 deaths reported annually, followed by colon and rectal cancers with over 50,000 deaths. Anyone of any age, gender, or ethnic background can acquire cancer. The average age of a patient with cancer is 55. There are an estimated 15.5 million cancer survivors in the United States. The first chart displays the ACS's estimates for new cases in 2018. The 2<sup>nd</sup> chart displays the estimated number of deaths in 2018.

There are more than 100 different diseases that are known by the general name of Cancer. There are many kinds of cancer and all cancers start because abnormal cells grow out of control creating a mass of cells that does not normally belong in the body. Untreated or ignored cancers may cause serious illness and death.

**Figure 3. Leading Sites of New Cancer Cases and Deaths – 2018 Estimates**



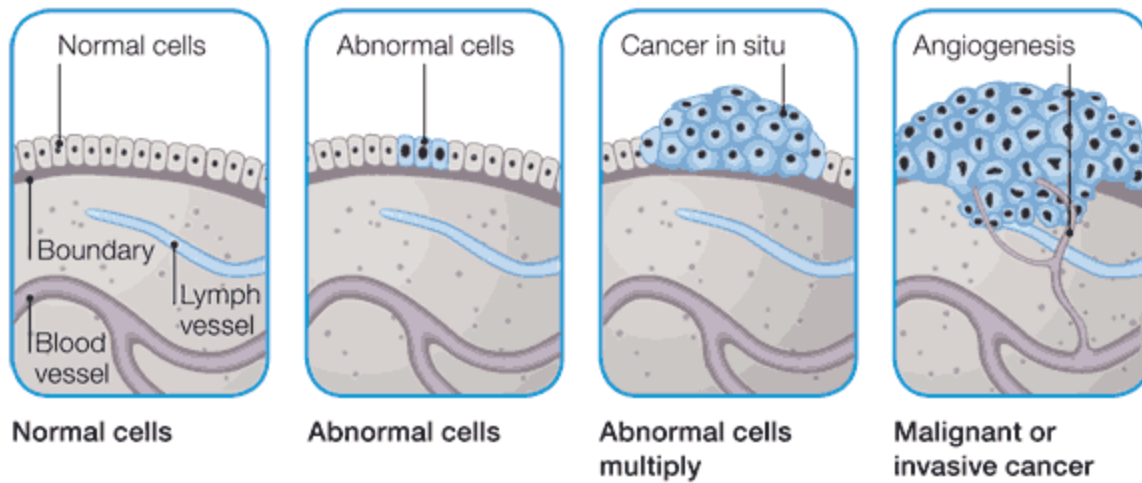
Estimates are rounded to the nearest 10, and cases exclude basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder. Ranking is based on modeled projections and may differ from the most recent observed data.

©2018, American Cancer Society, Inc., Surveillance Research

## HOW DOES CANCER BEGIN?

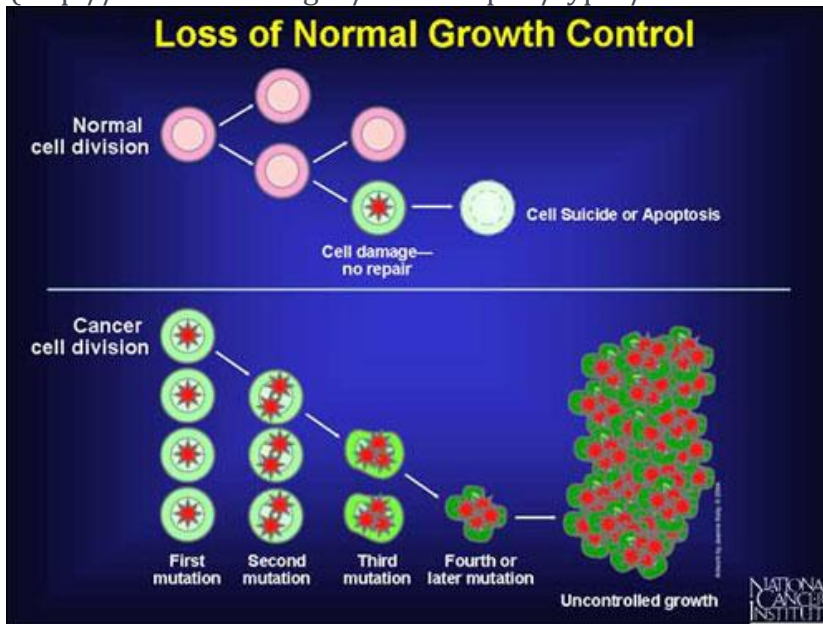
The body is made up of 50 to 75 trillion living cells. Normal body cells grow at a controlled rate. Each cell will have different life durations depending on where the cell originates from.<sup>i</sup> Many cells only get divided if they are worn out, dying or need repair due to injury. Depending on the type of cell, the lifespan and schedule for division will vary. A healthy cell will be able to regulate this process. When a cell's DNA becomes damaged, the ability to regulate division will become impacted.

Every person has cancer cells in their body. It is believed that we all have cells that have the potential to develop into cancer. They might not show up on customary test results until the cells have multiplied into a few million to a billion cells. When the immune system of a person is stronger than the cancer cells, the cancer will be destroyed and prevented from multiplying and forming tumors. Cancer starts when cells in an organ start to multiply at an out of control rate. When Cancer cells grow, it is very different than normal cell growth. Instead of the cell becoming worn out and dying, cancer cells continue to grow and form new cells that are abnormal. Cancer cells can and many times will attack or invade other surrounding healthy tissue. This is not a characteristic of a normal cell. Normal cells know when to stop growing. This is so that each type of tissue or organ has the right amount of each type of cell. Cancer cells do not have the controls that tell them when to stop growing. Multiplying out of control and invading other tissue is what makes a cell a cancer cell.



Cancer cells are created because of DNA that is damaged in some way. DNA is in every cell and carries the genetic information that is needed to direct the cell on how it should grow and divide. In a normal cell life, if DNA is damaged, the cell either repairs the damage or dies. In cancer cells, the damaged DNA is not repaired and the cell does not die. Instead, the cell begins to create new cells that have the same **DNA mutation** that the first damaged cell has. These new cells that have been created by the fast multiplication of mutated cells form what is called a **tumor**. Over time, the tumor can replace normal tissue, crowd it, or push it aside. These new tumors that are cancerous are referred to as **malignant**.

(<http://www.cancer.gov/cancertopics/types/commoncancers>)



## HOW DOES A PERSON GET CANCER?

In some cases, the risk for cancer can be inherited from previous generations if a person has inherited a genetic (DNA) mutation that predisposes a person to cancer. This does not mean they are certain to get cancer. Instead, a person may need one or more other genetic mutations to cause cancer. A person's inherited gene mutation could make them more at risk than other people to develop cancer. When exposed to a certain cancer-causing substance, or a carcinogen, the risk for cancer is increased and

possibly more likely. Research is not clear on how many mutations must be present for cancer to form. It's likely that this varies among the various types of cancer.

There are many different types of carcinogens that humans are exposed to on a regular basis. A carcinogen is anything that can cause cancer. These different carcinogens include pathogens, radiation, and chemicals. Some carcinogens occur naturally, while others are produced by human actions. Here are some examples:

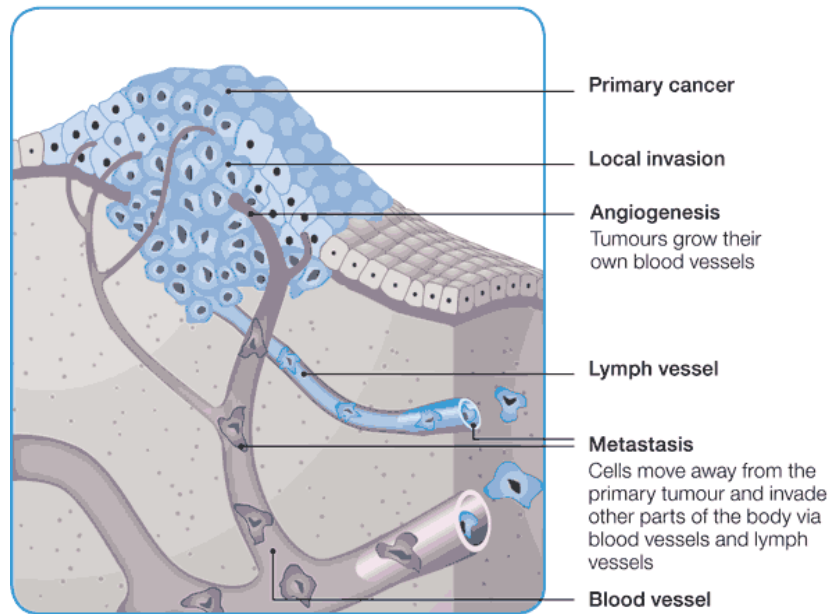
- Viruses cause about 15 percent of all human cancers. For example, the virus called Hepatitis B causes liver cancer.
- Ultra Violet radiation is the leading cause of skin cancer.
- The insulation that was used in construction and automotive industries called asbestos caused Mesothelioma and lung cancer.
- Tobacco smoke contains dozens of carcinogens, including nicotine and formaldehyde. Exposure to tobacco smoke is the leading cause of lung cancer.
- Vaping: The vapor have been found to contain propylene glycol, glycerin, nicotine, flavors, small amounts of toxicants, carcinogens, and heavy metals, as well as metal nanoparticles, and other substances. E-cigarette vapor potentially contains harmful chemicals not found in tobacco smoke.
- Marijuana Smoke
- Some chemicals that were previously added to foods, such as certain dyes, are now known to cause cancer. Cooking foods at very high temperatures also causes carcinogens to form. For example, barbecued foods are cooked at very high temperatures.

## THE SPREADING OF CANCER

Cancer cells have the ability to travel to other parts of the body where they can grow and form new tumors. The ability of the cancer to travel occurs in three ways:

1. To distant organs: the cancer is moving through the body's bloodstream.
2. To distant organs: the cancer has spread into the lymph vessels.
3. Locally: the cancer grows directly into nearby tissue.

The spreading of cancer or a secondary cancer is called **metastasis**. Some cancers, like leukemia, rarely form tumors like most cancers. Instead, these cancer cells involve the blood and travel through the body via the bloodstream. Cancer can create substances that stimulate them to move. A process called **angiogenesis** allows the tumors to grow their own blood vessels, which now allows the cancer to travel to distant tissues.



No matter where a cancer may spread to, it will always be named based on the origin of the organ. For example, liver cancer that has spread to the lung is called metastatic liver cancer, not lung cancer. In this case, cancer cells taken from the lung would be the same as those in the liver. The importance of identifying the origin of the cancer is what treatment will be most effective to treat the cancer.

## HOW DO CANCERS DIFFER?

Different types of cancer can behave very differently. For instance, many cancers will grow at different rates and respond to different treatments. This is why people with cancer need treatment that is aimed at their specific kind of cancer.

A **tumor** is an abnormal lump or collection of cells, but not all tumors are cancerous. Tumors that are not cancerous are called **benign**. Benign tumors can cause problems – they can grow very large and press on healthy organs and tissues which can effect proper functioning of the body. Benign tumors do not have the ability to grow into other tissue. Since the benign tumor is localized to a particular piece of tissue, they do not have the ability to spread to other parts of the body (**metastasize**). These tumors are seldom life threatening.

There are different stages in which cancer can be discovered and diagnosed. The beginning stage is 0, and then proceeds to stage I, II, III, or IV. Stage 0 means the cancer is “in situ”, or in other words is confined to the site in which it started. Stage I can indicate a larger tumor but can still be localized. Stages II through IV may indicate that the disease is progressing beyond its organ of origin. The higher the stage, the more advanced and more difficult the cancer may be to treat.

## 6.2 COMMON TYPES OF CANCER

### Skin Cancer

The skin is the largest organ in your body. Its many different jobs include covering internal organs and protecting them from injury, protecting the body from bacteria and viruses, controlling body temperature, helping to create vitamin D, and protecting the entire body from ultraviolet rays. The skin is made up of 3 separate layers. Depending on which layer of the skin the cancer is found will determine what form of skin cancer is present.

Skin Cancer is the most common form of cancer found in the United States. There are currently 10 or more different types of skin cancer. The most common form of skin cancer is Basal Cell Carcinoma. This is not only the most common type of skin cancer, but the most common type of cancer in humans. About 8 out of 10 skin cancers are Basal Cell Carcinomas.

These cancers usually develop on sun-exposed areas, especially the head and neck. Basal Cell Carcinoma was once found almost entirely in middle-aged or older people. Now it is also being seen in younger people, mostly because they are spending more time in the sun without protecting their skin.

These cancers tend to grow slowly. It's very rare for a basal cell cancer to spread to other parts of the body. But if a basal cell cancer is left untreated, it can grow into nearby areas and invade the bone or other tissues beneath the skin. After treatment, Basal Cell Carcinoma can come back in the same place on the skin. People who have had basal cell cancers are also more likely to develop this cancer somewhere else on the skin.

The next form of skin cancer is Squamous Cell Carcinomas. About 2 out of 10 skin cancers are these types. These cancers commonly appear on sun-exposed areas of the body such as the face, ears, neck, lips, and backs of the hands.

Melanoma is a cancer that can form different types of growths. These growths are called moles. These moles are normally benign. A mole that is dark or black, irregular in shape, or changing in size or shape could be diagnosed as a malignant tumor. Melanomas can occur anywhere on the skin, but they are more likely to start in certain locations. The chest and back are very common sites as well as legs, neck and face. In some cases, melanoma can develop on the palms of the hands, soles of the feet, and under the nails.

Melanoma is less common than basal cell and squamous cell skin cancers, but it is far more dangerous. Like basal cell and squamous cell cancers, melanoma is almost always curable in its early stages. But it is much more likely to spread to other parts of the body if not caught early, unlike the previous two.

In order to prevent any form of skin cancer, the ACS recommends that every person take the following precautions when exposed to the sun:

1. wear sunscreen of at least an SPF of 30 and be sure to reapply frequently, especially after swimming and sweating
2. wear a hat (especially if you have short hair or a shaved head) and sunglasses to protect the delicate skin around your eyes



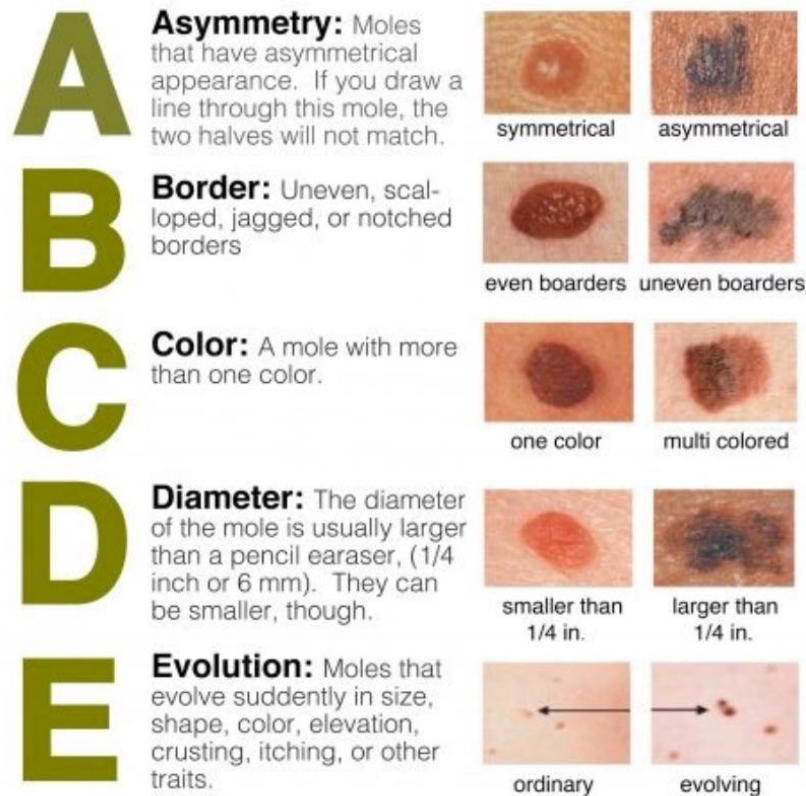
3. seek shade when outdoors for extended periods of time

4. always avoid tanning beds

The ACS also recommends routine skin checks to ensure that there are no changes in freckles, moles or other marks on the body. You may choose to visit a dermatologist annually, but you should also perform self-checks in between visits. Below you will find a chart that brings you through the ABC's of melanoma. It is a guide to help you understand the difference between normal marks and a freckle or mole that should be checked out. You can also refer to the website link for more information.

## The ABCDE checklist

The ABCDE guideline is one of two commonly used strategies for early detection of melanoma.



**WATCH NOW: The ABC's of Melanoma Detection**

<http://www.cancer.org/cancer/skincancer-melanoma/detailedguide/melanoma-skin-cancer-signs-and-symptoms>

## Lung Cancer

Lung cancer is the leading cause of death by cancer in the United States with 27% and is the second most common cancer for both men and women. There are two different types of lung cancer.

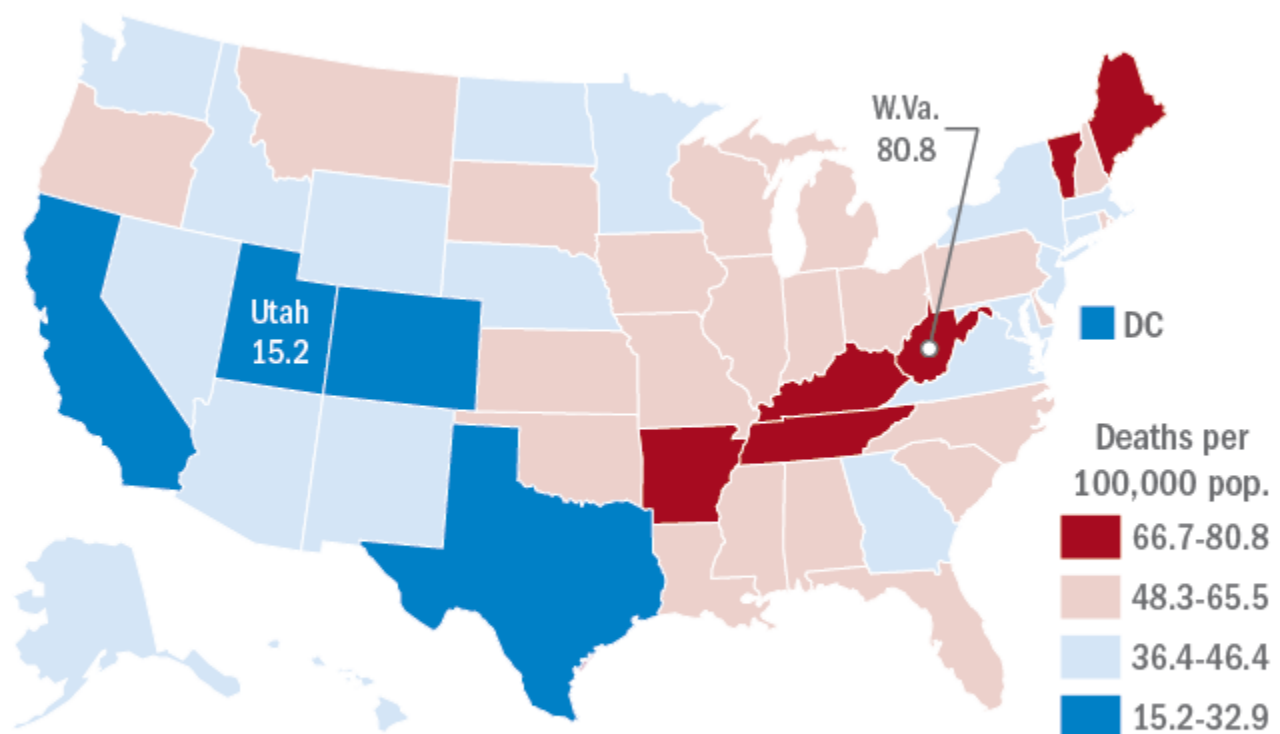
The American Cancer Society's estimates for lung cancer in the United States for 2018 are:

- About 234,000 new cases of lung cancer
- An estimated 159,260 deaths from lung cancer

There are two classifications of lung cancer: small cell lung cancer and non-small cell lung cancer. There are two main differences between these cancers; first, the treatment is very different for each of these cancers; and second, the size and shape of the cell is different as well. Very often these two different forms of lung cancer are linked to a history of smoking. For smokers the risk of either form of lung cancer is much higher, while for non-smokers the risk is lower.

*Below is an image of the estimated lung cancer deaths in the United States in 2018.*

### Estimated lung cancer death rates for 2018



Frontline Medical News

Note: Based on 2001-2015 mortality data from the National Center for Health Statistics.

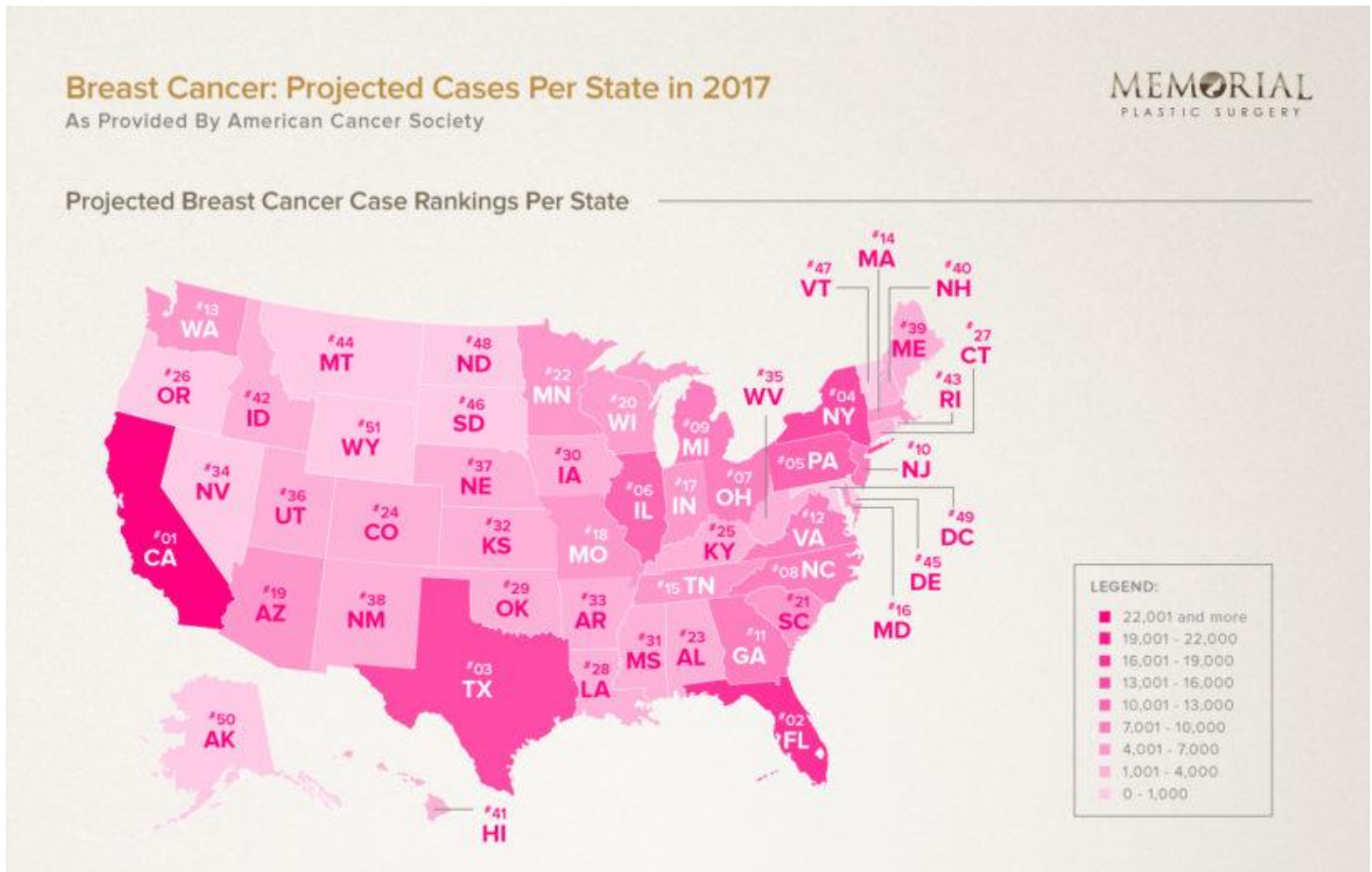
Source: American Cancer Society



## Breast Cancer

Breast cancer is a malignant tumor that starts in the cells of the breast. A malignant tumor is a group of cancer cells that can grow into and invade surrounding tissues or spread (metastasize) to distant areas of the body. The disease occurs almost entirely in women, but men can get it too. It is estimated that there will be almost 267,000 new cases in 2018 with over 41,000 deaths caused by breast cancer. The American Cancer Society estimates that for men, the lifetime risk of getting breast cancer is about 1 in 1,000. While in women, The American Cancer Society estimates about 1 in 8 (12%) women in the U.S. will develop breast cancer during their lifetime

*Below is an image of the amount of projected deaths in the years 2017.*



Click the link below to see what the most common cancers are.

<http://www.cancer.gov/cancertopics/types/commoncancers>

## 6.3 THE TREATMENT OF CANCER

**Surgery** can and is very often used to diagnose, treat, or even help prevent cancer. Surgery can include biopsies, which remove a sample of tissue or an entire lesion. Biopsies are used to test tissue and determine if a growth is benign or cancerous. Most people with cancer will have some type of surgery. It often offers the greatest chance for cure, especially if the cancer has not traveled to other parts of the body.

**Chemotherapy** is the use of medicines or drugs to treat cancer. The use of chemotherapy can normally work throughout the entire body. This medication is often given intravenously or can be given in pill form. Chemotherapy, or often referred to as “chemo,” can kill cancer cells that have metastasized. More than 100 chemo drugs are used in many combinations. A single chemo drug can be used to treat cancer, but often multiple drugs are carefully administered in a specific order and regimen to provide the greatest chance for recovery. Multiple drugs with different actions can work together to kill more cancer cells. This can also reduce the chance that the cancer may become resistant to any one chemo drug. Chemotherapy will attack any fast generating cell that is found in the body, with this idea, chemo will also attack health cells in the body. Very often chemo will attack hair cells and immune system cells. In response to these cells being attacked, some patients will lose their hair and will be susceptible to illness while undergoing treatment. Chemotherapy drugs can be taken in a pill form but are most commonly administered in a liquid form intravenously (directly into the bloodstream). Chemo regimens vary on a case by case basis. An individual may be treated daily, weekly, or monthly.

**WATCH NOW:** Click the link to watch videos on research to find a cure to cancer.

<http://www.cancer.org/research/researchvideos/index>

**Radiation** therapy uses high-energy particles or waves to destroy or damage cancer cells. It is one of the most common treatments for cancer, either by itself or along with other forms of treatment like chemotherapy. Special equipment sends high doses of radiation to the cancer cells or tumor. It causes small breaks inside the DNA of each cell and keeps the cell from multiplying and creating more cancer cells. Radiation can also affect normal cells near the tumor. Normal cells can repair themselves and cancer cells cannot. Sometimes radiation can clear the body of cancer, while other times radiation will be used to slow the cancer’s growth. Unlike chemotherapy, which exposes the entire body to cancer fighting drugs, radiation therapy is targeted and affects only the part of the body being treated.

**Immunotherapy** is a treatment that uses certain strengths of a person’s immune system to fight disease. By stimulating the body’s immune defenses, the body may become strong enough to fight cancer cells. Over the past few decades, the use of immunotherapy has increased and has become an important component of treatment plans for many patients. Immunotherapy works better for some types of cancer than others. While the body’s immune system is designed to recognize, attack and destroy foreign matter, like germs, it has difficulty targeting cancer cells. Immunotherapy helps the immune system to recognize cancer cells and strengthen the response. The main types of immunotherapy treatment include:

- manmade antibodies that are designed to attack specific parts of the cells
- cancer vaccines that promote an immune response to the disease
- treatment called “check-point inhibitors” which help the immune system recognize and attack cancer cells

**Blood transfusions** have become a very frequently used part of cancer treatments. The following are reasons why transfusions become imperative:

- Some cancers cause internal bleeding, which can lead to anemia.
- Blood cells are made in the bone marrow, the spongy center of certain bones. Cancers that start in the bone marrow or cancers that spread there from other places may crowd out normal blood-making cells, leading to low blood counts.
- People who have had cancer for some time may develop medical conditions that affect the production and lifespan of red blood cells.
- Cancer can also lower blood counts by affecting organs such as the kidneys and spleen, which help keep enough cells in the blood.

Due to other treatments to fight cancer, it may call for the need of a transfusion:

- Surgery to treat cancer may lead to blood loss and the need for red blood cell or platelet transfusions.
- Chemotherapy will often affect the bone marrow. With bone marrow being affected, it can lead to low blood cell counts, and can sometimes put a person at risk for life-threatening circumstances.
- If large areas of the bones are affected due to radiation, it can affect the bone marrow and lead to low blood cell counts.

## **6.4 PREVENTING CANCER**

There are many ways that we may try to prevent all forms of cancer and many of these ways will keep ourselves healthy from other diseases and illness as well.

1. Control your weight. Maintaining a healthy weight not just reduces the risk of cancer, it can also reduce the risk of heart disease and diabetes.
2. Eating a well-balanced diet.
  - Read food labels to become more aware of portion sizes and calories. Be aware that “low-fat” or “non-fat” does not necessarily mean “low-calorie.”
  - Eat smaller portions when eating high-calorie foods.
  - Choose vegetables, whole fruit, legumes such as peas and beans, and other low-calorie foods instead of calorie-dense foods such as French fries, potato and other chips, ice cream, donuts, and other sweets.
  - Limit your intake of sugar-sweetened beverages such as soft drinks, sports drinks, and fruit-flavored drinks.
  - Eat at least 2½ cups of vegetables and fruits each day.
  - Choose whole grains instead of refined grain products.
  -
3. Be more active.
  - For young people, it is recommended to have at least 60 minutes of moderate to vigorous activity each day, occurring at least 3 days each week.

4. As an adult, alcohol use should be a very limited use.
5. Quit smoking, or never start smoking and limit the amount of second hand smoke you are exposed to.

**List of cancer awareness months**

<http://www.choosehope.com/calendar-of-cancer-awareness-months>

**List of all cancer types**

<http://www.cancer.org/cancer/showallcancertypes/index>

---

<sup>i</sup> <http://www.livescience.com/33179-does-human-body-replace-cells-seven-years.html>  
4/11/2011