# Assignment On-
# Anticancer (recent Approaches & advantages of anticancer Treatments)

**Course Code: BPH 423**
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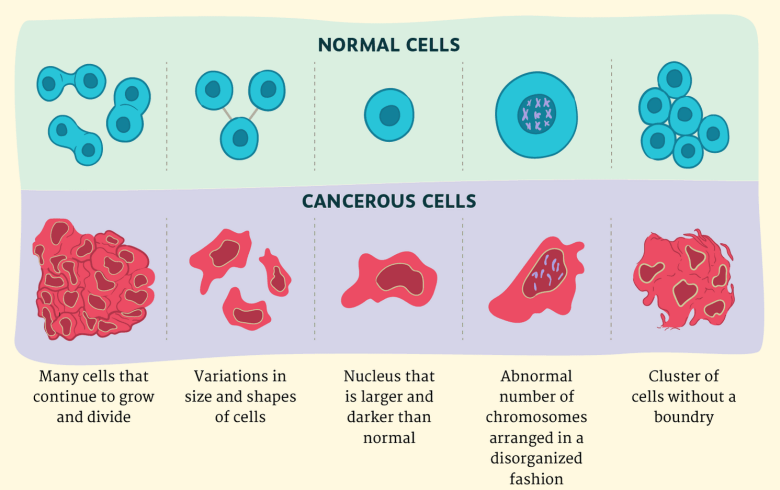
# The Definition of Cancer

Cancer is a disease in which some of the body's cells grow uncontrollably and spread to other parts of the body.

Cancer can start almost anywhere in the human body, which is made up of trillions of cells. Normally, human cells grow and multiply (through a process called cell division) to form new cells as the body needs them. When cells grow old or become damaged, they die, and new cells take their place.

Sometimes this orderly process breaks down, and abnormal or damaged cells grow and multiply when they shouldn't. These cells may form tumors, which are lumps of tissue. Tumors can be cancerous or not cancerous (benign).




Cancerous tumors spread into, or invade, nearby tissues and can travel to distant places in the body to form new tumors (a process called metastasis). Cancerous tumors may also be called malignant tumors. Many cancers form solid tumors, but cancers of the blood, such as leukemias, generally do not.

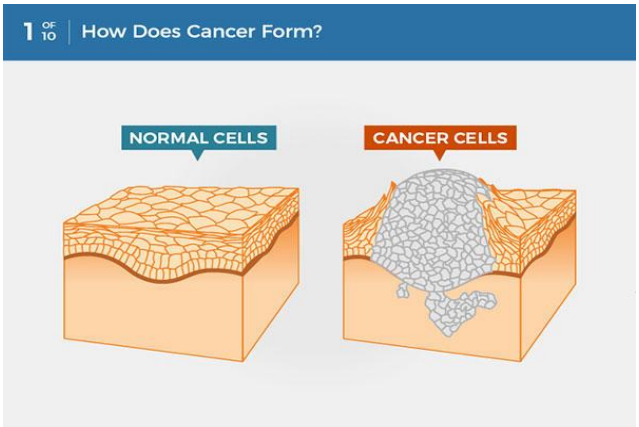
Benign tumors do not spread into, or invade, nearby tissues. When removed, benign tumors usually don't grow back, whereas cancerous tumors sometimes do. Benign tumors can sometimes be quite large, however. Some can cause serious symptoms or be life threatening, such as benign tumors in the brain.

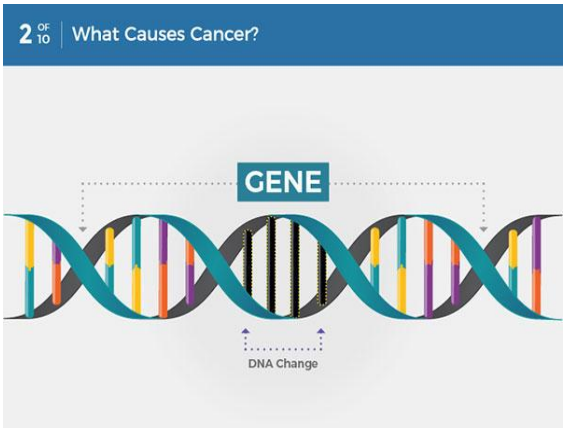
# How Does Cancer Develop?

Cancer is a genetic disease—that is, it is caused by changes to genes that control the way our cells function, especially how they grow and divide.

**Genetic changes that cause cancer can happen because:**

- Of errors that occur as cells divide.
- Of damage to DNA caused by harmful substances in the environment, such as the chemicals in tobacco smoke and ultraviolet rays from the sun. (Our Cancer Causes and Prevention section has more information.)
- They were inherited from our parents.




The body normally eliminates cells with damaged DNA before they turn cancerous. But the body's ability to do so goes down as we age. This is part of the reason why there is a higher risk of cancer later in life.

Each person's cancer has a unique combination of genetic changes. As the cancer continues to grow, additional changes will occur. Even within the same tumor, different cells may have different genetic changes.

# Types of Cancer

There are more than 100 types of cancer. Types of cancer are usually named for the organs or tissues where the cancers form. For example, lung cancer starts in the lung, and brain cancer starts in the brain. Cancers also may be described by the type of cell that formed them, such as an epithelial cell or a squamous cell..

Here are some categories of cancers that begin in specific types of cells:

## Carcinoma

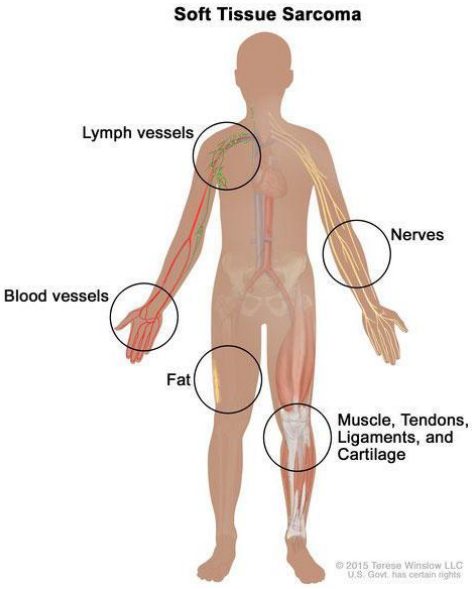
Carcinomas are the most common type of cancer. They are formed by epithelial cells, which are the cells that cover the inside and outside surfaces of the body. There are many types of epithelial cells, which often have a column-like shape when viewed under a microscope.

Carcinomas that begin in different epithelial cell types have specific names:

- **Adenocarcinoma** is a cancer that forms in epithelial cells that produce fluids or mucus..
- **Basal cell carcinoma** is a cancer that begins in the lower or basal (base) layer of the epidermis, which is a person's outer layer of skin.
- **Squamous cell carcinoma** is a cancer that forms in squamous cells, which are epithelial cells that lie just beneath the outer surface of the skin. Squamous cells also line many other organs, including the stomach, intestines, lungs, bladder, and kidneys. Squamous cells look flat, like fish scales, when viewed under a microscope. Squamous cell carcinomas are sometimes called epidermoid carcinomas.
- **Transitional cell carcinoma** is a cancer that forms in a type of epithelial tissue called transitional epithelium, or urothelium. This tissue, which is made up of many layers of epithelial cells that can get bigger and smaller, is found in the linings of the bladder, ureters, and part of the kidneys (renal pelvis), and a few other organs. Some cancers of the bladder, ureters, and kidneys are transitional cell carcinomas.

## Sarcoma

Sarcomas are cancers that form in bone and soft tissues, including muscle, fat, blood vessels, lymph vessels, and fibrous tissue (such as tendons and ligaments).




**Osteosarcoma** is the most common cancer of bone. The most common types of soft tissue sarcoma are leiomyosarcoma, Kaposi sarcoma, malignant fibrous histiocytoma, liposarcoma, and dermatofibrosarcoma protuberans.

## Leukemia

Cancers that begin in the blood-forming tissue of the bone marrow are called leukemias. These cancers do not form solid tumors. Instead, large numbers of abnormal white blood cells (leukemia cells and leukemic blast cells) build up in the blood and bone marrow, crowding out normal blood cells. The low level of normal blood cells can make it harder for the body to get oxygen to its tissues, control bleeding, or fight infections.

## Multiple Myeloma

Multiple myeloma is cancer that begins in plasma cells, another type of immune cell. The abnormal plasma cells, called myeloma cells, build up in the bone marrow and form tumors in bones all through the body. Multiple myeloma is also called plasma cell myeloma and Kahler disease.

## Melanoma

Melanoma is cancer that begins in cells that become melanocytes, which are specialized cells that make melanin (the pigment that gives skin its color). Most melanomas form on the skin, but melanomas can also form in other pigmented tissues, such as the eye.

## Lymphoma

Lymphoma is cancer that begins in lymphocytes (T cells or B cells). These are disease-fighting white blood cells that are part of the immune system. In lymphoma, abnormal lymphocytes build up in lymph nodes and lymph vessels, as well as in other organs of the body.

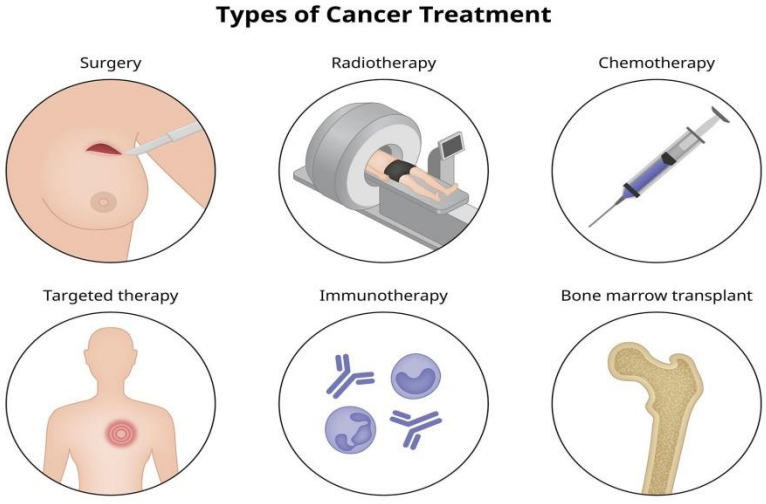
# Types of Cancer treatment

Cancer treatment is the procedure to remove, destroy or restrict the growth of cancer cells in your body. Oncology is the medical specialty that focuses on the diagnosis and treatment of cancer.

There are many different approaches to treat cancer. The 3 most common approaches are –

- surgery,
- radiotherapy and
- Chemotherapy.

The ideal treatment option is selected based on the location of the tumor, stage of the cancer and other patient factors



## Surgery

- Surgery is another very commonly used method for dealing with cancer. It simply involves cutting out the parts of the body with cancer. Cancer surgery is routine for many cancer types (breast, prostate) but may be difficult for others (brain, heart).
- Usage in India: extremely common.
- Availability: nearly every large Indian cancer hospital will have a department for surgery. Leading private hospitals often also have robotics or other advanced surgical equipment.

## Radiation Therapy

- Radiation or radiotherapy is often used in combination with other treatments, especially surgery. It is used to destroy all cancer and healthy cells in a certain area in the body. Radiotherapy is commonly used for certain cancer types including leukemia and lymphomas but not available for other cancer types. Radiotherapy does not work for metastatic cancers as it's not typically possible to give radiation to different parts of the body at the same time.
- Usage: extremely common.
- Availability: Nearly every large India cancer hospital will have radiation therapy equipment.

## Targeted Therapy

- Targeted therapies try to target specific gene mutation(s) which are driving the cancer. By targeting specifically cancer cells and not healthy cells (as with the options listed above), targeted therapies aim to reduce unwanted effects. Targeted therapies vary greatly by cancer type and stage.
- Usage: common but price for many targeted therapies can be expensive, decreasing usage.
- Availability: Many targeted therapies are not available in India, including several popular options in the western world. However, the common therapies available (for example Gefitinib for non-small cell lung cancer) is readily available.

## Stem Cell Therapy

- Stem cell therapy is limited to a few cancer types and is usually given when a bone marrow transplant is required.
- Often used after chemotherapy or radiation therapy weakens the bones, requiring a transplant.
- Stem cells may be taken for the patient or from another individual.
- Usage: limited by cost and cancer type due to which stem cell therapy is not used too frequently.
- Availability: check with your hospital. Not available at every major cancer hospital.

## Anticancer Drug (Chemotherapy)

- Chemotherapy or chemo is widely used for cancer care in India and globally as well. The basic principle is that chemo kills cancer cells and healthy cells at a specific location in the body. Chemotherapy can be thought of as a poison, which keeps the cells from dividing, preventing cancer cells from reproducing. The biggest drawback of chemo is adverse effects.
- Usage: extremely common.
- Availability: nearly all types of chemo are widely available

The antineoplastic agents are historically, categorized as –

(1) alkylating agents,

(2) antimetabolites,

(3) natural products,

(4) hormones and antagonists, and

(5) Miscellaneous.

A classification of the antineoplastic agents with listing of individual agents is given below. There has been a steady increase in development of innovative antineoplastic agents in recent years and between 5 and 10 new anticancer agents are approved yearly

- **Alkylating Agents**
    - Carboplatin, Cisplatin, Oxaliplatin
- Antimetabolites
    - Antifolates: Methotrexate, Pemetrexed, Pralatrexate, Trimetrexate
    - Purine Analogues: Azathioprine, Cladribine, Fludarabine,
    - PyrimidineAnalogues: Azacitidine, Capecitabine, Cytarabine\
- **Biologic Response Modifiers**
    - Aldesleukin (IL-2), Denileukin Diftitox, Interferon Gamma
- **Hormonal Agents**
    - Antiandrogens: Abiraterone, Apalutamide, Bicalutamide, Cyproterone\
    - Antiestrogens : Anastrozole, Exemestane, Fulvestrant, Letrozole
    - Peptide Hormones: Lanreotide, Octreotide, Pasireotide
- **Monoclonal Antibodies**
    - Alemtuzumab, , Bevacizumab, , Cemiplimab, Cetuximab, Daratumumab, Din utuximab, Elotuzumab, Gemtuzumab
- **Miscellaneous**
    - Bexarotene, Eribulin, Everolimus, Hydroxyurea, Ixabepilone, Temsirolimus, Thalidomide, Venetoclax

# Recently approved Anticancer Drugs

The 1990s is an exciting decade for oncologists. Intensive research and development programs during the 1980s and 1990s have resulted in new anticancer agents with unique mechanisms of action and significant clinical activity. Recently, three such agents were approved by the FDA:

(1) paclitaxel (Taxol),
(2) all-trans-retinoic acid, and
(3) vinorelbine (Navelbine).

These agents have shown significant clinical activity in patients with refractory tumors, such as non-small-cell lung cancer, platinum-refractory ovarian cancer, and anthracycline-refractory breast cancer.

## Paclitaxel

Paclitaxel is a type of chemotherapy. It is a treatment for a number of different cancer types.

Paclitaxel works by stopping cancer cells from separating into two new cells. This blocks the growth of the cancer.

Paclitaxel is used as a drip into your bloodstream (intravenously).


You might have treatment through a long plastic tube that goes into a large vein in your chest. The tube stays in place throughout the course of treatment. This can be a:

- central line
- PICC line
- portacath

Paclitaxel is a cycles of treatment. This means that you have the drug and then have a rest to allow your body to recover.

Patient may have paclitaxel every 2 or 3 weeks. You might have it on its own or with other chemotherapy drugs.

Patients have to do blood tests before and during your treatment. They check your levels of blood cells and other substances in the blood. They also check how well your liver and kidneys are working.

**Doses forms**

Injection, powder, for suspension

**Common side effects**

These side effects happen in more than 10 in 100 people (more than 10%). You might have one or more of them. They include:

- Risk of infection
- Breathlessness and looking pale
- Bruising and bleeding
- Allergic reaction
- Numbness and tingling in hands and feet
- Low blood pressure (hypotension)
- Diarrhoea
- Feeling or being sick
- Sore mouth
- Hair loss
- Muscle and joint pain
- Urinary tract infections (UTIs)
-

## All-trans retinoic acid (ATRA)

All-trans retinoic acid (ATRA) is an active metabolite of vitamin A under the family retinoid. Retinoids, through their cognate nuclear receptors, exert potent effects on cell growth, differentiation and apoptosis, and have significant promise for cancer therapy and chemoprevention.


**Route of Administration**

- Tretinoin is given by mouth (in capsule form).
- One size capsule - 10mg, do not crush, chew or dissolve capsules. Protect from light.
- Take tretinoin with food.
- It also is used as a lotion (topical) for patients with acne and certain rashes.

The amount of tretinoin you will receive depends on many factors, including your height and weight, your general health or other health problems, and the type of cancer.

**Side Effects:**

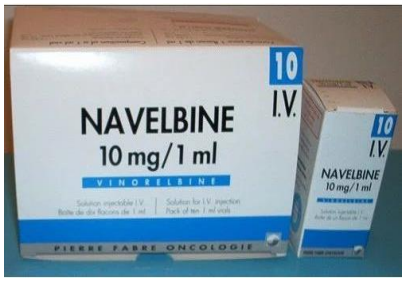
Important things to remember about Tretinoin side effects:

- Most people do not experience all of the Tretinoin side effects listed.
- Tretinoin side effects are often predictable in terms of their onset, duration, and severity.
- Tretinoin side effects will improve after treatment is complete.
- Tretinoin side effects may be quite manageable. There are many options to help minimize or prevent the side effects or tretinoin.
- There is no relationship between the presence or severity of tretinoin side effects and the effectiveness of the medication.

# vinorelbine (Navelbine)

Vinorelbine is a type of chemotherapy. It is also known as navelbine. You might have it as a treatment for:

- advanced breast cancer
- non small cell lung cancer
- cancer of the outer covering of the lung (mesothelioma)




patients might have vinorelbine on its own, with other chemotherapy drugs or radiotherapy.

Vinorelbine is a type of drug called a vinca alkaloid. It stops the cancer cells from separating into 2 new cells. So it blocks the growth of the cancer.

usually vinorelbine is a course of several cycles of treatment .

Patients have to do blood tests before and during your treatment. They check your levels of blood cells and other substances in the blood. They also check how well your liver and kidneys are working.

**Route of Administration**

1. Into your bloodstream

You might have treatment through a long plastic tube that goes into a large vein in your chest. The tube stays in place throughout the course of treatment. This can be a:

- central line
- PICC line
- portacath

2. Taking capsules

**Side effects**

These side effects happen in more than 10 in 100 people (more than 10%). You might have one or more of them. They include:

- Feeling or being sick
- Risk of infection
- Breathlessness
- Diarrhoea or constipation
- Hair thinning
- Sore mouth and throat
- Loss of reflexes
- High temperature (fever)
- Bruising and bleeding
- Fatigue (during and after treatment)

# New Approaches to Anticancer agents

There are some promising compounds that currently in clinical development. These drugs, which include –

1. topoisomerase I inhibitors,
2. docetaxel (Taxotere), gemcitabine (Gemzar), and t
3. hymidylate synthase (TS) inhibitors,

they have significant preclinical activity and are now undergoing phase I, II, and III clinical testing. The hope is that these novel compounds represent the first of a long line of new agents developed as a result of our better understanding of the biology and biochemistry of the cancer cell.

## Topoisomerase I Inhibitors

Topoisomerase I inhibitors are an exciting new class of antineoplastic agents currently undergoing clinical testing. These compounds are structurally related to camptothecin, a natural product isolated from the Chinese plant *Camptothecin accuminata.* These drugs are used to kill lung cancer (malignant) cells.

Topoisomerase inhibitors (TI) can inhibit cell proliferation by preventing DNA replication, stimulating DNA damage and inducing cell cycle arrest. Although these agents have been commonly used in the chemotherapy for the anti-proliferative effect, their impacts on the metastasis of cancer cells remain obscure .

## Docetaxel

Docetaxelis a semisynthetic analog of paclitaxel prepared from a noncytotoxic precursor extracted from the needles of the European yew tree *Taxus baccata* .Docetaxel was synthesized in 1986 and was selected for clinical development in 1987 due to its preclinical activity and a formulation that allowed for shorter infusion schedules than paclitaxel.

Docetaxel is approved to be used alone or with other drugs to treat:

- **Breast cancer** that has spread and has not gotten better with other chemotherapy. It is also used with doxorubicin hydrochloride and cyclophosphamide to treat breast cancer that is node-positive and can be removed by surgery.
- **Non-small cell lung cancer** that has spread. It is used:
    - Alone in patients whose cancer has not gotten better after platinum chemotherapy; or
    - With cisplatin in patients whose cancer has not been treated and cannot be treated with surgery.
- **Prostate cancer** that has spread to other parts of the body in men whose cancer is castrate resistant (has not responded to treatments that lower testosterone levels).
- **Squamous cell carcinoma of the head and neck** that is locally advanced. It is used with cisplatin and fluorouracil.

- **Stomach adenocarcinoma** or **gastroesophageal junction adenocarcinoma** (a rare type of esophageal cancer) that is advanced. It is used in patients whose cancer has not been treated with chemotherapy.

## Thymidylate synthase (TS) inhibitors

Thymidylate synthase inhibitors are chemical agents which inhibit the enzyme thymidylate synthase and have potential as an anticancer chemotherapy.[1] This inhibition prevents the methylation of C5 of deoxyuridine monophosphate (dUMP) thereby inhibiting the synthesis of deoxythymidine monophosphate (dTMP). The downstream effect is promotion of cell death because cells would not be able to properly undergo DNA synthesis if they are lacking dTMP, a necessary precursor to dTTP.] Five agents were in clinical trials in 2002: raltitrexed, pemetrexed, nolatrexed, ZD9331, and GS7904L.

Examples include

- Raltitrexed, used for colorectal cancer since 1998 [4]
- Fluorouracil, used for colorectal cancer[5]
- BGC 945[6]
- OSI-7904L[7]

# New Approaches to Anticancer Therapy

The chemotherapeutic compounds described above have direct cytotoxic effects on cancer cells through interaction with DNA, RNA, or protein synthesis. Another approach to cancer therapy is the use of agents that alter the cellular phenotype and thereby induce a less malignant state. Examples of such agents are angiogenesis inhibitors, differentiating agents, signal transduction inhibitors, and gene therapy.

The section below will focus on **three angiogenesis inhibitors** that are currently undergoing phase I/II testing.

## Angiogenesis Inhibitors

Angiogenesis is the formation of new blood vessels. This process involves the migration, growth, and differentiation of endothelial cells, which line the inside wall of blood vessels.

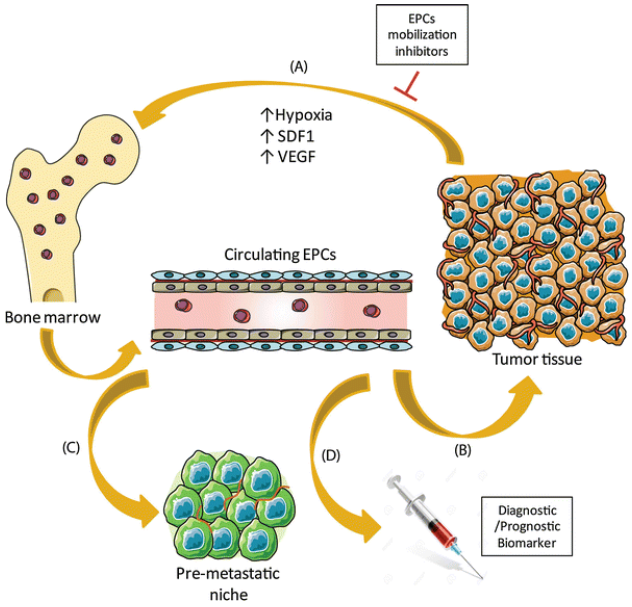
Angiogenesis plays a critical role in the growth of cancer because solid tumors need a blood supply if they are to grow beyond a few millimeters in size. Tumors can actually cause this blood supply to form by giving off chemical signals that stimulate angiogenesis. Tumors can also stimulate nearby normal cells to produce angiogenesis signaling molecules.

The resulting new blood vessels “feed” growing tumors with oxygen and nutrients, allowing the tumor to enlarge and the cancer cells to invade nearby tissue, to move throughout the body, and to form new colonies of cancer cells, called metastases.

Because tumors cannot grow beyond a certain size or spread without a blood supply, scientists have developed drugs called angiogenesis inhibitors, which block tumor angiogenesis. The goal of these drugs, also called antiangiogenic agents, is to prevent or slow the growth of cancer by starving it of its needed blood supply.

**How do angiogenesis inhibitors work?**

Angiogenesis inhibitors are unique cancer-fighting agents because they block the growth of blood vessels that support tumor growth rather than blocking the growth of tumor cells themselves.




Angiogenesis inhibitors interfere in several ways with various steps in blood vessel growth. Some are monoclonal antibodies that specifically recognize and bind to VEGF. When VEGF is attached to these drugs, it is unable to activate the VEGF receptor. Other angiogenesis inhibitors bind to VEGF and/or its receptor as well as to other receptors on the surface of endothelial cells or to other proteins in the downstream signaling pathways, blocking their activities. Some angiogenesis inhibitors are immunomodulatory drugs—agents that stimulate or suppress the immune system—that also have antiangiogenic properties.

In some cancers, angiogenesis inhibitors appear to be most effective when combined with additional therapies. Because angiogenesis inhibitors work by slowing or stopping tumor growth without killing cancer cells, they are given over a long period.

Approved angiogenesis inhibitors include:

- Axitinib (Inlyta®)
- Bevacizumab (Avastin®)
- Cabozantinib (Cometriq®)
- Everolimus (Afinitor®)
- Lenalidomide (Revlimid®)
- Lenvatinib mesylate (Lenvima®)
- Pazopanib (Votrient®)
- Ramucirumab (Cyramza®)
- Regorafenib (Stivarga®)
- Sorafenib (Nexavar®)
- Sunitinib (Sutent®)
- Thalidomide (Synovir, Thalomid®)
- Vandetanib (Caprelsa®)
- Ziv-aflibercept (Zaltrap®)

Tecogalan sodium, recombinant human platelet-factor 4, and TNP-470 are three angiogenesis inhibitors that are currently being tested in cancer patients.

1. **Tecogalan sodium** is a sulfated polysaccharide polypeptidoglycan isolated from the cell walls of the bacterium *Arthrobacter* .Its antiangiogenic effect is thought to be mediated by inhibition of the binding of basic fibro-blast growth factor to endothelial cell receptors.Phase I clinical trials of tecogalan in solid tumors and in AIDS-related Kaposi's sarcoma (KS) are currently being conducted at several sites. The primary toxicities observed to date have been fever, rigors, and prolongation of the activated partial thromboplastin and prothrombin times . The coagulation toxicities have been ameliorated by prolonging the infusion duration at a given dose. Several standard dosing schedules of this compound are being investigated, as well as prolonged administration by continuous intravenous infusion.
2. 
3. **Recombinant human platelet factor 4** is an antiangiogenic protein undergoing phase I/II testing in metastatic colon carcinoma and AIDS-related KS. When used via an intralesional injection in AIDS-related KS, this compound produced a 57% response rate in injected lesions (two complete responses) . The primary toxicity was pain at the injection site. A dose-finding study in metastatic colon cancer examined schedules utilizing 30-minute infusions given up to 5 times a week; no significant biochemical, hematologic, or coagulation toxicities were noted .
4. 
5. **TNP-470** is a fumigillin analog that has demonstrated potent antiangiogenic activity both in vitro and in vivo .Phase I/II studies are currently being conducted in AIDS-related KS and hormone-refractory prostate cancer. Although no measurable responses have been reported, in one AIDS-related KS trial two patients given the higher dose levels experienced significant reductions in painful extremity edema. Toxicities have been mild, and consist primarily of fatigue without muscle weakness.

# Latest Advancements in Cancer Treatment

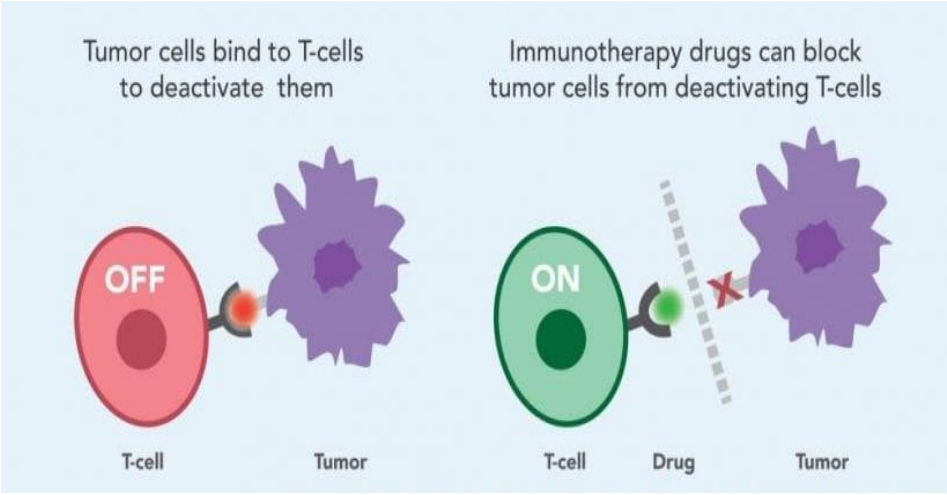
Cancer killed nearly 10 million people in 2020 and is a leading cause of death globally, according to the World Health Organization. Breast cancer, lung cancer and colon cancer are among the most common cancers.

Death rates from cancer were falling before the pandemic. Now COVID-19 has caused treatment. But medical advances are continuing to help the world fight cancer. Here are some recent developments.

## Immunotherapy

Immunotherapy is a form of cancer treatment that boosts the body's natural defences to help it fight cancer. The therapy has resulted in a significant improvement in cancer treatment. Immune checkpoint inhibitors are one type of medicine that works by releasing the brakes on the body's immune system, allowing it to attack cancer cells.

The immune system may reduce or even stop cancer growth after locating and responding to the malignancy. With the advancement of immunotherapy, new insights into how and when these novel medicines operate are becoming available.




Patients with a diverse array of solid tumor and blood malignancies now have additional therapeutic options thanks to immunotherapy research and clinical trials. New cancer-fighting breakthroughs are bringing us closer to a time when cancer will be a curable disease.

According to recent clinical trial findings combining **radiation treatment for lung cancer** with immunotherapy can considerably enhance lung cancer patient survival while also reducing adverse responses.

## Artificial Intelligence (AI)

The replication of human intelligence actions by robots or machines is known as Artificial Intelligence (AI). According to new research from the Institute of Cancer Research in London, AI can recognize patterns in breast cancer that are beyond the human eye's ability to see. It opens up new therapy options for patients who have ceased responding to traditional hormone therapy.

AI can regulate the usage of chemotherapy medications and forecast their tolerance, allowing the chemotherapy regimen to be optimized.AI can assist doctors in making the best treatment decisions, reducing unnecessary procedures, and helping oncologists in improving cancer treatment programs for their patients.

## Precision Medicine

Precision medicine examines how a specific gene modification (gene mutation) may impact a person's likelihood of developing particular cancer or how their genes (or genes in their cancer cells) may impact therapy if they already have cancer.

The method employs data from genetic testing to assist doctors in putting together a treatment plan that often includes exact suggestions. Precision medicine can help produce a more accurate diagnosis and enhance therapy in some circumstances.

In other circumstances, if a person is at risk for specific cancer, it can assist them in making decisions regarding healthy behaviours, early screening tests, and other preventative measures.

## Robotic Surgery

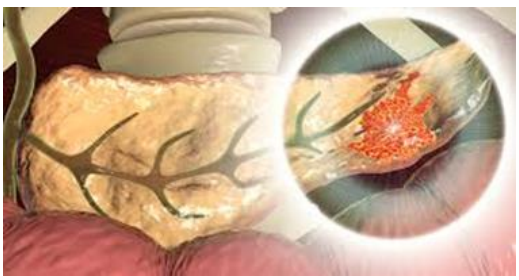
The doctor uses tools and cameras to put minor wounds in the body during robotic surgery. They sit at a computer and operate robotic arms employing hand and foot controls while seeing through a viewfinder.

The robotic arm can access hard-to-reach bodily areas and is more accurate than the surgeon's hands. This form of surgery can help to lessen blood loss and discomfort following the treatment. It can also help to cut down on the length of time spent in the hospital.

Robotic surgery is used in lung cancer treatment, melanoma treatment, prostate cancer therapy, and ovarian cancer treatment.

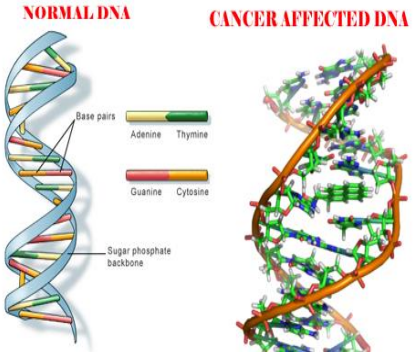
## Fighting pancreatic cancer

Pancreatic cancer is one of the deadliest cancers. It is rarely diagnosed before it starts to spread and has a survival rate of less than 5% over five years. At the University of California San Diego School of Medicine, scientists have developed a test that was able to identify 95% of early pancreatic cancers in a study. The research, published in Nature Communications Medicine, explains how biomarkers in extracellular vesicles – particles that regulate communication between cells – were used to detect pancreatic, ovarian and bladder cancer at stages I and II.



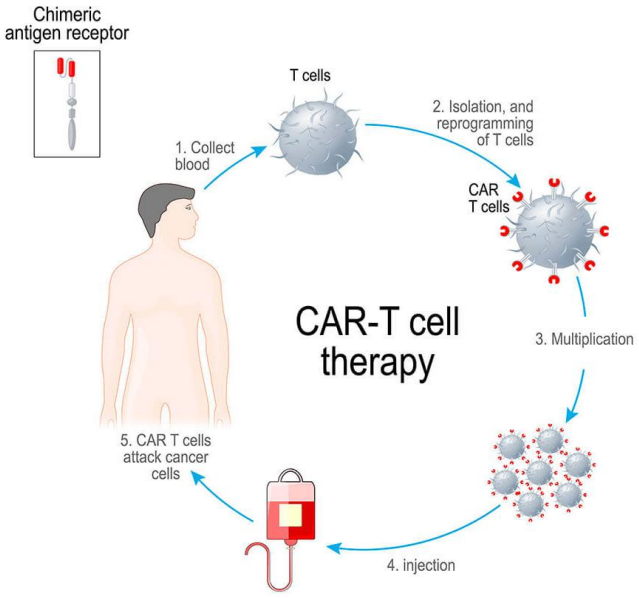
## Clues in the DNA of cancer

At Cambridge University Hospitals in England, the DNA of cancer tumors from 12,000 patients is revealing new clues about the causes of cancer, scientists say. By analyzing genomic data, oncologists are identifying different mutations that have contributed to each person's cancer. For example, exposure to smoking or UV light, or internal malfunctions in cells. These are like "fingerprints in a crime scene", the scientists say – and more of them are being found. "We uncovered 58 new mutational signatures and broadened our knowledge of cancer," says study author Dr Andrea Degasperi, from Cambridge's Department of Oncology.




## The chimeric antigen receptor (CAR) T-Cell Therapy

T-cells, a kind of fighter cell in the immune system, defend the body against viruses and other intruders. (CAR) T-cell therapy is a treatment that allows T-cells to fight cancer more efficiently. It has been so far successful in the diagnosis and remission of leukemia.




T-cells are initially removed from the blood by doctors. The cells' genes are then altered to aid in the detection and destruction of cancer cells. Finally, the T-cells are put back in the body.

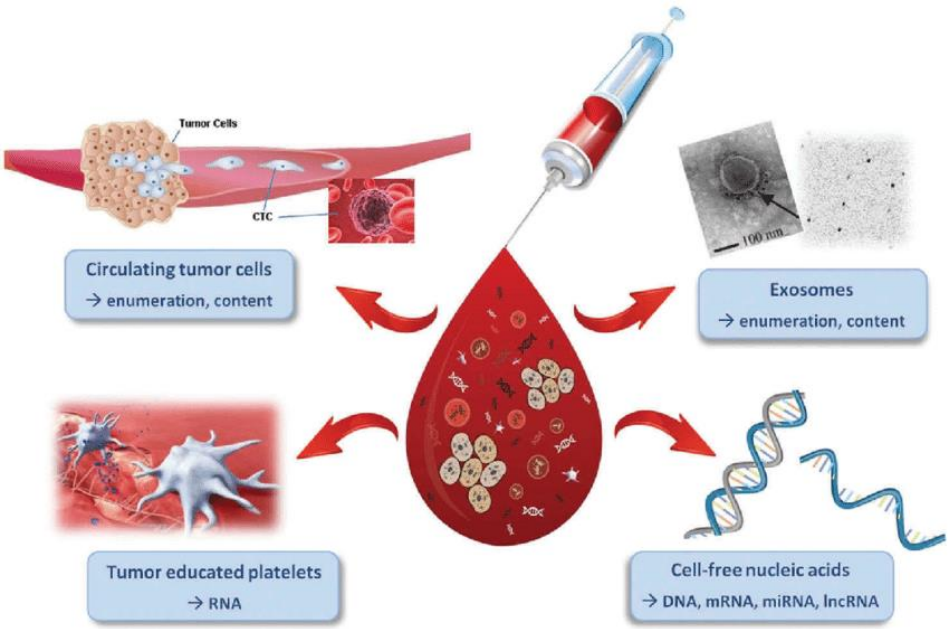
## Liquid Biopsy

Biopsies are the main way doctors diagnose cancer – but the process is invasive and involves removing a section of tissue from the body, sometimes surgically, so it can be examined in a laboratory.

The sample and study of non-solid biological tissue, typically blood, is known as liquid biopsy or fluid phase biopsy. It is a ground-breaking method for detecting cancer early and determining how effective treatment is working. Multiple blood samples taken over time may also aid doctors in determining what molecular alterations are occurring in a tumor.

Many malignancies release circulating tumor cells (CTCs) and other indicators into the circulation as the disease progresses. CTC analysis allows for collecting a liquid biopsy from a patient's blood, predicting and monitoring therapy response and tumor recurrence.

Synthetic biopsies are another innovation that can force cancer cells to reveal themselves during the earliest stages of the disease.



# Conclusion and Perspective

Cancer has become a tangible threat to human health. About 9.6 million people are estimated to die from the various forms of cancer each year, according to a statistic report (Collaborators, 2019). Cancer has become the second-largest disease that causes human death (Reimann et al., 2020). However, developing a new drug molecule costs 12 years and 2.7 billion USD on average. The drug development for cancer even becomes more complicated, especially considering the molecular pharmacology is still not well understood. Hence, the discovery and development of new drugs is considered very expensive and time-consuming. In this respect, computational methods could be constructive for performing different tasks including protein-interaction network analysis, drug-target prediction, binding site prediction, virtual screening, and many others. All these innovative methods could considerably facilitate the anti-cancer drug discovery. In recent years, with the advance of AI, more sophisticated methods, such as retro-synthetic routine plan, drug scaffold generation, drug binding affinity predictions, were developed. The useful predictions generated by computational models combined with experimental validations could further speed up the anti-cancer drug development.

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