

Undefeated Cancer

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ABSTRACT:

The most common serious disease today is cancer, which is on the rise as a result of the kind of life we live. Cancer is a 'Uncontrolled Growth of the cells' which can be prevented if diagnosed earlier stages. The numerous internal and external elements producing cancer will determine how it is treated. These days, a variety of treatments, involving gene therapy, chemotherapy, surgery, radiation therapy, immunotherapy, etc., are available to treat cancer. Up to 2030, it is expected about 22.2 million cases will receive a cancer diagnosis.

Keywords: (Cancer, Types, Carcinogen, Gene Therapy, Treatment, Diagnosis, Immunotherapy)

Introduction:

Uncontrolled cell development and spread are a common feature of the group of disorders known as cancers. Death may occur if the metastasis, or spread of cancer cells, which marks this stage, is not stopped. Tobacco, chemicals, radiation, and chance mutations are a some of the outside causes that contribute to cancer. Cancer has numerous, intricate, and incompletely known causes. Numerous factors, such as dietary elements, specific illnesses, a lack of physical exercise, obesity, and environmental toxins, are known to raise the risk of cancer. [1]

Cancer is the most dangerous and fatal disease which not cure in earlier stages it may causes death. With an estimated 14.1 million new cases and 8.2 million deaths directly connected to cancer in 2012, compared to 12.7 million infections in 2008, cancer remains the most common cause of death in worldwide.... [2]

These factors may interact to initiate or promote carcinogenesis in the human body, resulting in cancer being the leading cause of death.

In India, cancer is become one of the most common causes of dea kiths. There are considered to be around 2 and 2.5 million cancer cases globally at any given moment. Annually, there are nearly 7 lakh new cases of cancer and 3 lakh deaths. At any given time, around fifteen lakh patients require facilities for diagnosis, treatment, and follow-up.[3]

Despite beginning with one cell, we have over 30 trillion cells in our bodies. Repeatedly, this cell divides, and each of its copies grows another copy of itself. These cells eventually come together to form an entire human person.

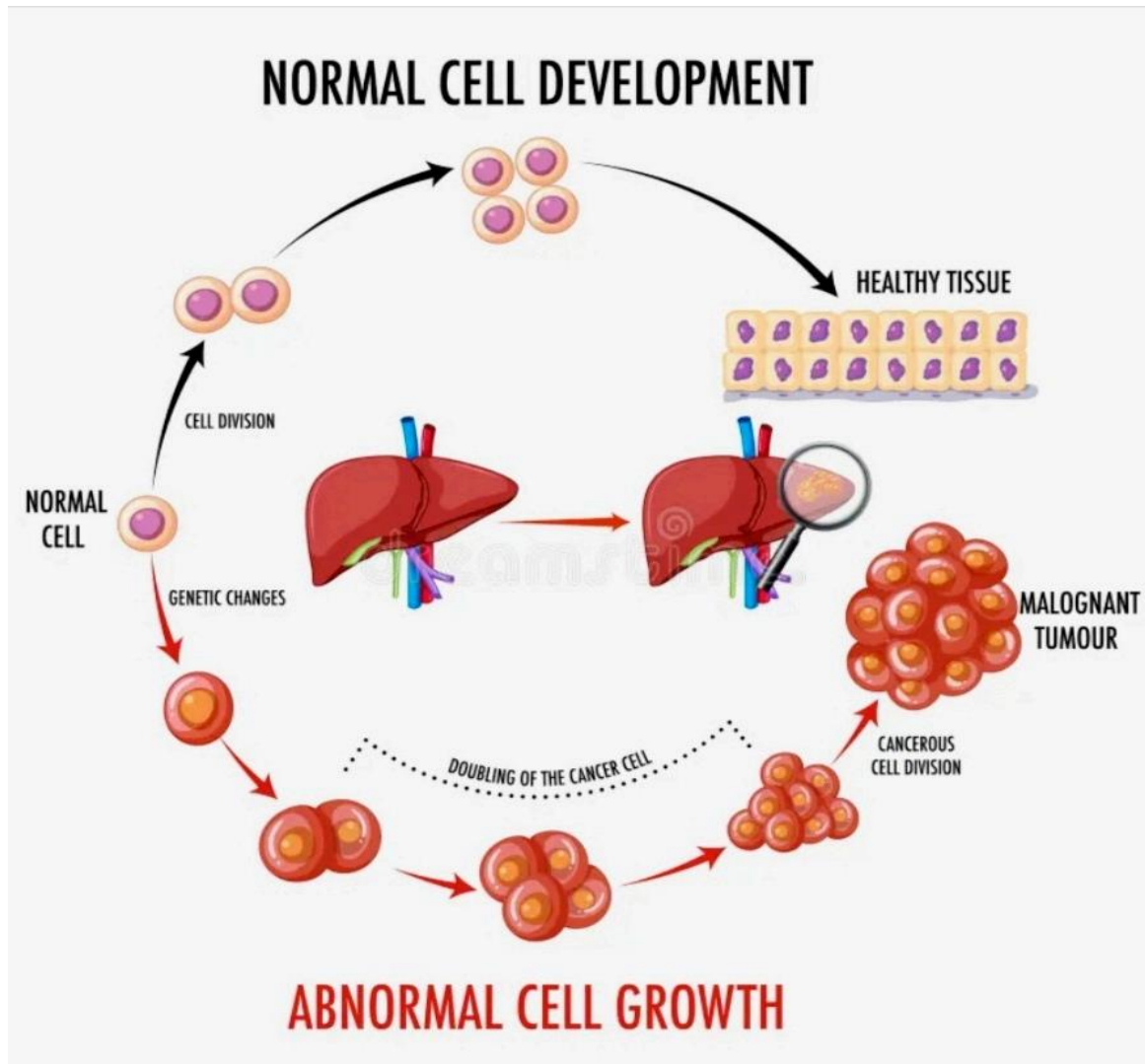


Fig 1 : Normal & Cancer cell in human

Early cells, often known as stem cells, are undifferentiated. This indicates they have the potential to become any type of cell but have not specialized. Once a sufficient number of cells have been created, new cells begin to differentiate

When cells die or are injured, they must be replaced, therefore cell division is a continuous process that occurs throughout our lives. The human body generates approximately 300 billion new cells per day. More over half of these are red blood cells, which only live for about 120 days and are regularly replaced. This is a perfectly normal procedure.

A tumor develops when there is an error in the copying process and the reproduced cell is defective. The biggest error is that they continue to replicate themselves indefinitely. Furthermore, they are frequently unspecialized or undifferentiated, thus they serve no purpose and do not go through normal cell life cycles.

Because the cells continue to divide, they might eventually form a lump or mass that affects the area of the body in which they reside. This body part may therefore be unable to function properly or may not function at all. [4]

Carcinogens:-

Carcinogenesis is the process through which healthy cells turn into malignant cells or the generation of cancer cells.

A substance acknowledged to be capable of causing cancer is known as a carcinogen, and it is what initiates the carcinogenesis process. These carcinogens change the DNA (genetic material) of the cells they enter into, which causes harm to the cells. The cell subsequently develops a mutation and begins to expand and divide uncontrollably into several mutant cells. Chemical, radiation, and nutritional carcinogens are some of the various types of cancer-causing agents.

Causes of Cancer:-

1. Viruses such the Human Papillomavirus (HPV), Hepatitis B virus (HBV), along with Epstein-Barr virus
2. Ionizing radiation, ultraviolet (UV) radiation, and exposure to chemicals such as vinyl chloride, benzene, and asbestos are just a few examples of environmental and occupational exposure.
3. Habits like cigarette smoking, alcohol consumption, consuming high-fat, low-fiber foods, etc.
4. Medications such as immunosuppressant's and alkylating agents
5. Genes such as cancer-causing genes, genetic mutations, and faulty tumour suppressor genes. [5]

Types of cancer :- (Based on the tissue affected)

- Carcinoma's : The Cells that cover both internal and external body parts, such as cells found in lung, breast, and colon cancer, are known as carcinomas.
- Sarcoma's : Cells found in bone, cartilage, fat, connective tissue, muscle, and other supportive tissues are what define sarcomas.
- Lymphoma's : Cancers called lymphomas develop in the immune system and lymph nodes.
- Leukemia's : Cancers called leukemia develop in the bone marrow and usually grow up in the bloodstream.
- Adenoma's : These are the cancerous cells that grow in the thyroid gland, the pituitary gland, the adrenal gland, and other glandular tissue. [6]

Types of cancer:- (Based on the Organ affected)

- Lung cancer
- Liver cancer
- Bladder cancer
- Cervical Cancer
- Stomach cancer
- Bone cancer
- Brain cancer
- Breast cancer
- Non-Hodgkin's lymphoma
- Cancers of Urinary system etc.[7]

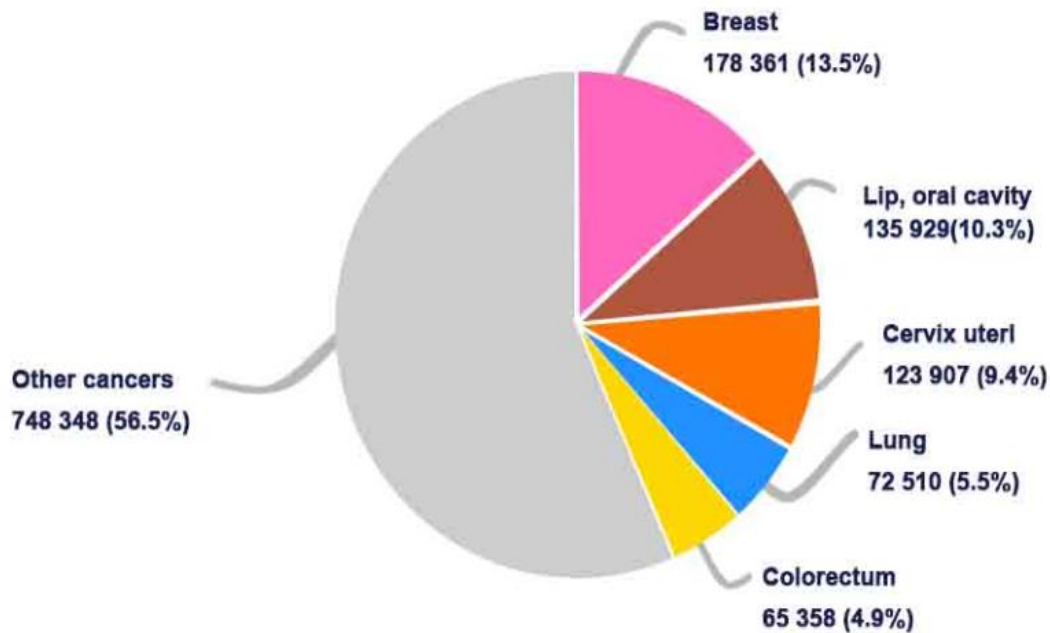


Fig 2 : Pie chart represent the number of new cases in 2020.

Cancer statistics :

- In India, a woman dies of cervical cancer every eight minutes. [8] For every 2 women newly diagnosed with breast cancer, one woman dies of it in India [9,10]
- In 2018, the usage of tobacco (both smoked and smokeless) caused around 3,17,928 fatalities in both men and women.
- Over 3500 people per day are thought to die in India from tobacco-related causes.[11]

Cancer Statistics in India : [12]

- Around 2.7 million cancer patients are anticipated worldwide in 2020.
- 13.9 lakh new cases of cancer are reported annually.
- 8.5 lakh people have died from cancer.

Indians face an increased risk of developing cancer before the age of 75 :

- Overall (including both sexes): 1 in 9
- 1 in 68 men are male.
- 1 in 29 are females.

Cancer mortality risk among Indians before age 75 :

- 1 in 22 rural males/females.
- 1 in 20 urban males.
- 1 in 24 urban females. [13]

Cancers of the mouth cavity, stomach, and lungs account for more than 25% of cancer fatalities in men, while cancers of the uterine cervix, breast, and oral cavity account for 25% of cancer deaths in women.[14]

The top five malignancies in men and women account for 47.2% of all cancers; these diseases can be avoided, checked for, discovered, and treated early. [15] This could drastically lower the number of people dying from these cancers.

Although the battle against cancer has not yet been won, it has also not been lost. Cancer is being turned into a chronic disease with improved survival rates and quality of life as basic and clinical research continues.

	WOMEN	MEN
1)	BREAST	LIP,ORAL CAVITY
2)	CERVIX UTERI	LUNG
3)	OVARY	STOMACH
4)	LIP ,ORAL CAVITY	COLORECTAL
5)	COLORECTAL	ESOPHAGUS

Symptoms:-

The symptoms of cancer depend on the type and location of the cancerous cells and where they grow. For example, in case of ' Lung cancer' may result in coughing, breathlessness or chest pain.

And in case of 'colon cancer' may result in diarrhoea , constipation etc....

In some cases there is no symptoms of cancer at all. In other carcinomas, like pancreatic cancer, symptoms usually don't appear until the condition grows greatly.

Mostly, the following symptoms are shown in cancer:

- Loss of appetite
- Chills
- Fatigue
- Night sweat
- Weight loss
- Unusual upset stomach
- unexpected bleeding or discharge
- Any injury that doesn't get healed.
- Unexpected thinking in the breast or other part.
- Uncontrolled cell growth.
- Formation of growth. [16]

Treatment for cancer

1] Gene Therapy:

What is Gene Therapy..?

In order to cure a specific disease, a defective gene is replaced with a healthy copy in a method known as gene therapy. In order to rectify the defects in the cancer tissue or to trigger an immune reaction

against the cancer cells, gene therapy involves delivering genetic components to the cancer cell or to immune response cells. The corrective strategies can include replacing missing or damaged genes, such as tumour suppressor genes, inhibiting the activity of oncogenes that promote cancer, or instructing normal or cancer.

A good target to replace or modify, a carrier that delivers the gene of Interest to the cell, successful targeting of the vector, and sufficient expression of the therapeutic genes in the target cells are some requirements for a successful gene therapy treatment in cancer. Safety is also crucial for the. Treatment to be successful, in addition to having significant therapeutic efficacy. In order to cure a specific disease, a defective gene is replaced with a healthy copy in a method known as gene therapy. [17,18,19]

The second step in gene therapy following the Identification of a suitable gene is to introduce it into the target cell. Genes have been introduced into cells using a variety of vehicles (vectors), including cell-based carriers, non viral vectors, and viral vectors. In cancer gene therapy, retroviruses, adenoviruses, and adeno-associated viruses are usually used as viral vectors.

The ability of the virus to enter cells and alter how they function is used by the gene therapist for therapeutic purposes. In order to produce a full therapeutic viral vector, the therapeutic genetic element is first incorporated into the viral backbone.

Alternatively, fat droplets known as liposomes or nanoparticles can be used to deliver the therapeutic genetic elements to the cancer cells. Genes themselves can be administered locally or systemically in the form of naked DNA or DNA packed into particles.

1) Viral vectors

2) Non viral vectors

1) Viral Vectors:-

As vectors for cancer gene therapy, retroviruses, adenoviruses, and herpes viruses have all been thoroughly studied.

Retroviruses :

Retroviruses are single-stranded RNA viruses that consist of a 5' to 3' long terminal repeated sequence and a structural gene. A retrovirus that has one or more structural genes deleted can integrate foreign genes, which are also known as "transgenes." A retrovirus that has one or more structural genes deleted can integrate foreign genes, which are also known as "transgenes." When the recombinant virus infects a target cell, it integrates into the host genome and expresses viral genes as well as the transgene. Retroviral vectors with defects are not able to further replication. The easy process of genetic building using these vectors is advantageous. Also retroviruses elicit little host immune-response. Little to no target-cell selectivity and formation into only actively dividing cells is disadvantages. Retroviral vectors can also induce insertional mutagenesis and potentially transform target cells.[20]

Adenovirus:

Adenoviruses contain a double-stranded DNA core-Protein-complex surrounded by a protein capsid. There are two main stages of transcription for the adenoviral genome. DNA replication starts in the early phase, and the late phase starts 6–8 hours later. Adenoviral vectors are made by deleting the E1 genes, which prevents the virus from replicating and, as a result, prevents host cells from being transformed. A

stably integrated portion of the adenoviral genome that provides E1 activity is present in 293 cells, which are the source of the E1-deleted adenoviral vector. Adenoviral vectors are more effective to retroviral vectors in that they are highly effective at infecting both dividing and non-dividing cells and can carry larger DNA segments.

The main drawback of the adenovirus vector is that they induce antiviral immunity response. When using an adenoviral vector to challenge an immune-competent host again, transgenic expression may be diminished.[21,22]

2) Non-viral vectors :- (liposomes)

Liposomes is an example of the non viral vectors . Liposomes contains positively charge lipid membranes that complex with DNA. Hydrophilic polyanion nucleic acids can be steadily maintained in the liposome microenvironment. Transferring DNA into cells is done by the liposome complex fusing with negatively charged cell membranes. Liposomes do not trigger an immune response, but their ability to transfer genes is less effective than that of viruses (panel). Another non-viral method of gene transfer is the injection of naked plasmid DNA. Plasmids have several beneficial characteristics over viral-based delivery systems, such as a lack of immunological reaction to the vector components and less concern for host DNA damage.[23,24]

Fig 3 : Cancer Treatment Types

Cancer treatment types :

- Surgery
- Radiation Therapy
- Chemotherapy
- Immunotherapy
- Hormone Therapy
- Targeted Therapy
- Stem Cell Therapy

1) Surgery:-

Surgery to treat cancer involves removing a tumor from the body. The surrounding healthy tissue may occasionally also be removed. It is the most traditional form of cancer treatment, and it is still effective against many cancer forms today.

A specialist in cancer surgery is referred to as a surgical oncologist. Other types of specialists that specialize in cancer or other forms of surgery may also perform cancer surgeries.

Surgery can be carried out in a hospital, clinic, surgery center, or doctor's office. The location of the procedure is determined by the type of surgery and the amount of time you will need to recover under the supervision of your medical team.

You can go home the same day or the day after surgery if you don't need to be monitored for a long period of time. It is referred to as ambulatory surgery or outpatient surgery. You can spend more than one night in the hospital if you require prolonged monitoring. It is referred to as inpatient surgery.

You might need anesthesia—a type of medication—for your procedure in order to block your perception of pain. Depending on the type and complexity of the surgery, there are many types of anesthesia. Study up on anesthetic.[25]

Some forms of cancer cannot be treated with surgery. These include tumors of the lymphatic system (lymphoma) as well as the blood system (leukemia). The reason for this is that malignant malignancies frequently spread throughout the body. If the cancer is spread throughout the body, surgery won't completely eradicate it.

Cancer surgery can be performed in a variety of ways. Sometimes, surgeons will combine these. You may have:

- Keyhole (laparoscopic) surgery - Through a series of tiny skin incisions and the use of a laparoscope, the surgeon performs keyhole (laparoscopic) surgery to view into your body and remove tissue.
- Robotic surgery - The surgeon performs keyhole surgery with the assistance of a robotic device.
- Open surgery - The doctor creates a significant skin incision.
- Endoscopic surgery - Through a tube (endoscope) inserted into your body, typically through your mouth or back channel (rectum), the surgeon removes or destroys tissue.[26]

2) Radiation Therapy :

Radiation therapy, which contributes to 40% of the curative treatment for cancer, is still a crucial part of the fight against cancer, with about 50% of all cancer patients undergoing it at some point in their illness. Radiation therapy's principal objective is to rob cancer cells of their ability to divide and multiply.

Radiation therapy, also known as radiotherapy, is still a crucial modality used in the treatment of cancer together with surgery and chemotherapy. It is also a highly cost-effective single modality therapy, making up only around 5% of the whole cost of cancer care.[27]

Additionally, radiation therapy is thought to be administered to 50% of cancer patients at some point throughout their disease,[28,29] with a 40% curative therapeutic contribution from radiation therapy.[30] Similar to the majority of anticancer therapies, radiation therapy works by causing various forms of cell death to have its therapeutic impact[Ref 31]. Radiation therapy does not instantly eradicate cancer cells. Before cancer cells begin to die, it may take hours, days, or weeks of treatment. They then continue to die for weeks to months after radiation therapy.

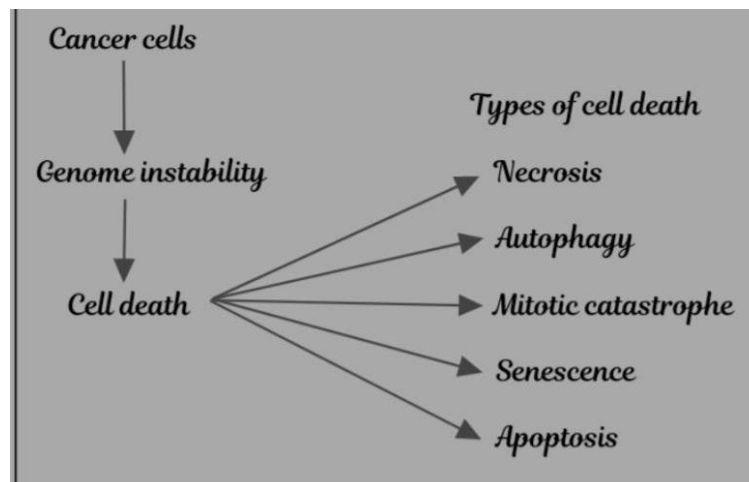


Fig 4 : Types of cell death induced by Radiation.

Several different mechanisms can be used in radiation treatment to kill cancer cells. Radiation therapy's primary objective is to rob cancer cells of their ability to proliferate and ultimately destroy the cancer cells. Cancer cells that can no longer divide due to DNA damage pass away.

The mechanism causing cell death in reaction to radiation exposure is intricate, though. Therefore, understanding the significance of radiation-induced cell death and additional processes involved could have therapeutic ramifications for patients.

3) Chemotherapy :

The basic mechanisms of chemotherapy are;

- The prevention of the emergence of drug-resistant Mycobacterium tuberculosis
- The bactericidal activity of drugs
- The principles of intermittent drug dosage.

The initial use of nitrogen mustards and antifolate medications in the 1940s marked the beginning of the age of chemotherapy[32]. Since then, the discovery of cancer drugs has gone from being a low-budget, government-supported research project to a high-stakes, multi-billion dollar enterprise. The principles and constraints of chemotherapy that the early researchers found still hold true despite the advent of the targeted-therapy revolution.

Cancer chemotherapy is the administration of cytotoxic substances, or substances capable of killing cells, with the goal of, in some situations, eradicating the tumor or, at the very least, reducing the tumor burden and, consequently, reducing the symptoms associated with the tumor and, possibly, extending life. Most cytotoxic medications are administered intravenously. This has been shown to be the most effective strategy to prevent tumor exposure to cytotoxic medications, while some medications can also be taken orally.

To maximize the likelihood of overcoming tumor cell resistance, increase the regimen's efficacy against various tumor cell clones, and prevent severe harm to normal organs, cytotoxic medications are typically administered in specific combinations of two or more medications[33].The development of the various chemotherapy regimens has mostly relied on empirism up until this point.

What are the side effects of chemotherapy?

Cancer cells aren't the only thing that chemotherapy kills. It can potentially create negative effects by damaging some healthy cells.

You could experience many, few, or no adverse effects at all. Depending on your body's response and the type and quantity of chemotherapy you receive [34].

Some common side effects are:

- Mouth sores
- Fatigue
- Nausea and vomiting
- Pain
- Hair loss
- Nausea
- Vomiting
- Diarrhea

- Loss of appetite
- Fever
- Mouth sores
- Constipation
- Easy bruising
- Bleeding

Prolonged and late-onset negative effects:

- Lung tissue injury
- Heart issues
- Infertility
- kidney issues
- Damage to the nerves (peripheral neuropathy)
- Risk of a second cancer.

Determining the chemotherapy medications that you'll consume :

Your doctor evaluates the chemotherapy medications you'll receive on a number of considerations including ;

- Type of cancer
- Stage of cancer
- Overall health
- Previous cancer treatments
- Your goals and preferences [35].

Chemotherapy Cycles :

Chemotherapy is often administered over the course of several treatment sessions, with recovery times in between. Your body can recover from the adverse effects during the rest interval. Additionally, it enables your blood's healthy cell count to return to normal.

A cycle of your treatment is made up of chemotherapy and the recovery phase. Your oncologist will outline the number of cycles required to successfully treat your cancer.

You will have a better understanding of what to anticipate after your first cycle. It could take several months for you to finish all of the necessary chemotherapy cycles[36].

Conclusion :-

Form the above data it is concluded that Cancer is the most dangerous and fatal disease which not cure in earlier stages it may causes death. With an estimated 14.1 million new cases and 8.2 million deaths directly connected to cancer in 2012, compared to 12.7 million infections in 2008, cancer remains the most common cause of death in worldwide. By using modern techniques like Immunotherapy, Radiation Therapy, Gene Therapy and chemotherapy we can treat the cancer but it cannot be cured completely.

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