About Cancer
Cancer is a disease of the body’s cells. Normal cells divide into two to repair damage or during growth. This growth is controlled in healthy cells. In cancer, the cells multiply out of control and may either form a lump (tumor) or produce too many white blood cells (leukemia). The growth and spread of malignant neoplasms is through the following ways: direct (infiltrate and destroy immediately adjacent structures) lymphatic invasion (to regional lymph nodes and beyond); blood vessel spread (usually to the lungs or liver or both); across serosal surfaces (pleura, pericardium and peritoneum).

Drug Delivery in Cancer Therapy
Drug delivery remains a challenge in the management of cancer. Drug delivery strategies for cancer vary according to the type and location of cancer. Conventional anticancer drugs are inherently toxic, drug delivery systems can be used to improve the solubility and stability of drug solutions to eliminate mixing and minimize exposure risks. The newer approaches to cancer treatment not only supplement the conventional chemotherapy and radiotherapy but also prevent damage to normal tissues and prevent drug resistance.

Cancer therapies are based on current concepts of molecular biology of cancer. These include antiangiogenic agents, immunotherapy, bacterial agents, viral oncolysis, targeting of cyclic-dependent kinases and tyrosine kinase receptors, antisense approaches, gene therapy and combination of various methods. Methods of immunotherapy in cancer involve use of cytokines, monoclonal antibodies, cancer vaccines and immunogene therapy.

Many anti-cancer drugs and therapies are as well known for the associated side effects as their therapeutic benefit. These instantly recognizable side effects can necessitate reduction of dosage of a drug, and can have a serious effect on the well-being of patients. New cancer drug delivery systems are in development to minimize harm to non-cancerous cells, whist enhancing the effect on the tumor itself.
Current Approaches to Cancer Therapy

Surgery for cancer
Depending on the extent of the tumor, surgery can remove the tumor mass and its surrounding tissue (margins).

Radiotherapy
Radiotherapy means the use of “radiation”, usually X-Rays, to treat disease. The radiation used is similar to that used for an X-Ray. Radiotherapy used to be called “radium treatment” or “deep X-Ray therapy” (DXT), but these names are a bit out of date these days because radiotherapy has improved technically over the years. Doctors have always been concerned about the dangers of radiation. But now, they have a lot of experience using it in medicine. Used properly, the risks are small and the benefits can be great. From outside the body, as external radiotherapy, using X-Rays, “cobalt irradiation”, electrons and more rarely other particles such as protons to destroy cancer cells. From within, as internal radiotherapy (brachytherapy) by placing radioactive material in or close to the tumor being treated. Radiotherapy destroys the cancer cells in the treated area. Although normal cells are also affected by radiation, they are better at repairing themselves than the cancer cells.

Immunotherapy
Hormones are natural substances made by glands in your body. The network of glands that make hormones is called the endocrine system. Hormones are carried in your bloodstream and act as messengers between one part of your body and another. They control the growth and activity of certain cells and organs in your body.

Hormone treatments use the sex hormones produced by our bodies, or drugs that block them, to treat cancer. Not all cancers respond to hormone therapy. Doctors might use hormone therapy for people with cancers that are “hormone sensitive” or “hormone dependent.” This means that the cancer needs the hormone to grow. Cancers that can be hormone sensitive are breast cancer, prostate cancer and womb cancer (uterine).

Cancers that are hormone sensitive or hormone dependent need hormones to grow. So stopping the hormone reaching the cancer cells may either slow down or stop the growth of the cancer. Hormone therapies can work by either stopping hormones being made or preventing the hormone to reach the cancer cell.

Chemotherapy
The term chemotherapy means treatment with cell killing, or cytotoxic, drugs. About 60 different drugs are currently available and new ones being developed all the time. Chemotherapy drugs damage cancer cells more than they damage healthy cells. The reasons for this are quite complicated. Body tissues are made of billions of individual cells. The body tissues grow because individual cells split into two, identical new cells. Cells that are in the process of dividing are more at risk of chemotherapy damage. And cancer cells divide much, much more often than most normal cells. Once we are fully grown, most of the body’s cells are not dividing. They spend most of their time in a resting state and only divide if damage repair is necessary. The rate of cell division is one of the reasons cancer is dangerous — tumor growth is fast and out of control.
Chemotherapy is more likely to kill cancer cells because a cell can only be damaged when it is dividing. In the center of each living cell is a dark blob, called the nucleus. The nucleus is the control center of the cell. It contains chromosomes, which are made up of genes. These genes have to be copied exactly each time a cell ‘grows’ by dividing into two. Chemotherapy damages the genes inside the nucleus of cells. Some drugs damage cells at the point of splitting. Some damage them while they are busy making copies of all their genes before they split. Cells that are at rest (most normal cells, for instance) are much less vulnerable to chemo damage. You may have a combination of different chemotherapy drugs. The combination will include chemo drugs that damage cells at these different stages in the process of cell division. With more than one type of drug, there is more chance of killing more cells.

The fact that chemo drugs kill dividing cells helps to explain why chemotherapy causes side effects. It affects healthy body tissues that grow all the time such as the skin, hair and digestive system. Normal cells can repair damage more quickly than cancer cells. So the damage to healthy cells does not usually last. Most side effects disappear once your treatment is over.

### Chemotherapeutic Drugs

- **Doxorubicin** (Adriamycin)
- **Aldesleukin or IL-2** (Proleukin)
- **Amsacrine** (acridinyl anisidide; m-AMSA)
- **Anastrozole** (Arimidex)
- **Bevacizumab** (Avastin)
- **Bicalutamide** (Casodex)
- **Bleomycin**
- **Busulfan**
- **Irinotecan** (Campto)
- **Capecitabine** (Xeloda)
- **Carboplatin** (Paraplatin)
- **Carmustine** (BCNU)
- **Chlorambucil**
- **Cisplatin**
- **Carmustine** (BCNU)
- **Cladribine** (2-CdA, Leustatin)
- **Crisantaspase** (asparaginase)
- **Cyclophosphamide**
- **Cyproterone acetate** (Cyprostat)
- **Cytarabine** (Ara C, cytosine arabinoside)
- **Dacarbazine** (DTIC)
- **Dactinomycin** (Actinomycin D)
- **Daunorubicin**
- **Disodium pamidronate** (Aredia)
- **Docetaxel** (Taxotere)
- **Doxorubicin** (Adriamycin)
- **Epirubicin**
- **Estramustine** (Emcyt, Estracyte)
- **Etoposide** (VP-16, Etopophos)
- **Exemestane** (Aromasin)
- **Fludarabine**
- **Fluorouracil** (5FU)
- **Flutamide** (Drogenil)
- **Gemcitabine** (Gemzar)
- **Goserelin** (Zoladex) for breast cancer
- **Goserelin** (Zoladex) for prostate cancer
- **Hydroxyurea**
- **Idarubicin** (Zavedos)
- **Ilospamide**
- **Interferon** (Roferon, Intron A)
- **Irinotecan** (Campto)
- **Interleukin**
- **Letrozole** (Femara)
- **Liposomal Doxorubicin** (Caelyx, Myocet, Doxil)
- **Lomustine** (CCNU)
- **Melphalan**
- **Mercaptopurine** (6-MP, Purinethol)
- **Methotrexate**
- **Mitomycin C**
- **Mitoxantrone**
- **Oxaliplatin** (Elotaxin)
- **Paclitaxel** (Taxol)
- **Pentostatin**
- **Procarbazine**
- **Raltitrexed** (Tomudex)
- **Sodium clodronate** (Bonefos, Loron)
- **Streptozocin** (Zanosar)
- **Steroids**
- **Tamoxifen** (Novadiex)
- **Paclitaxel** (Taxol)
- **Docetaxel** (Taxotere)
- **Tegafur with uracil** (Uftoral)
- **Temozolomide** (Temodal)
- **Tioguanine** (Latini, 6-TG, 6-tioguanine, Tabloid)
- **Thiotepa** (Thioplex, Triethylene thiophosphoramide)
- **Raltitrexed** (Tomudex)
- **Topotecan** (Hycamtin)
- **Trastuzumab** (Herceptin)
- **Tretinoin** (Vesanoid, ATRA)
- **Trenisulfan**
- **Vinblastine** (Velban)
- **Vincristine** (Oncovin)
- **Vindesine** (Elidasine)
- **Vinorelbine** (Navelbine)
- **Zoledronic acid** (Zometa)
Gene Therapy
Gene therapy is an experimental treatment that involves introducing genetic material into a person’s cells to fight or prevent disease. In most gene therapy studies, a “normal” gene is inserted into the genome to replace an “abnormal,” disease-causing gene. A carrier molecule called a vector must be used to deliver the therapeutic gene to the patient’s target cells. The most common types of vectors used in gene therapy are viruses. The viruses used in gene therapy are altered to make them safe; however, some risks still exist with gene therapy.

Researchers may use one of several approaches for correcting genes therapy:
• A normal gene may be inserted into a nonspecific location within the genome to replace a nonfunctional gene.
• An abnormal gene could be swapped for a normal gene through homologous recombination.
• The abnormal gene could be repaired through selective reverse mutation, which returns the gene to its normal function.
• The regulation (the degree to which a gene is turned on or off) of a particular gene could be altered.

Drug Delivery
Different drugs come in different forms—tablets, capsules, liquids or medicines to swallow. But there are drugs you cannot swallow because they irritate the stomach too much. Or because they would just pass straight through the gut without being absorbed by the body.

There are various ways of taking drugs without having to swallow them, including:
• By injection
• By injection into the muscle or just under the skin
• By slowly infusing them under the skin using a syringe driver
• As a suppository into the back passage
• As a skin patch
• As a tablet to dissolve under the tongue

Many conventional anticancer drugs currently employed in clinical chemotherapy regimens exhibit a narrow therapeutic window, often resulting in significant patient toxicity with the drug doses required to achieve optimal therapeutic responses. These instantly recognizable side effects can necessitate reduction of dosage of a drug, and can have a serious effect on the well-being of patients. New cancer drug delivery systems are in development to minimize harm to non-cancerous cells, whilst enhancing the effect on the tumor itself.

A drug delivery system can be either a new and innovative method of administering a drug or a novel twist on an existing drug. Drug delivery systems can offer significant advantages in cancer therapy. They not only allow the delivery of active drug substances that are difficult to formulate (overcoming inherent shortcomings of both biologicals and sparingly water-soluble active drugs) but also decrease the inherent toxicity of most
agents, increasing their efficacy (by modulation of the release kinetic from
the formulation and of the residence time in the body) and specifically
localizing the therapy to the site of action.

Several innovative methods of drug delivery are used in cancer. These
include use of microparticles as carriers of anticancer agents. These may be
injected into the arterial circulation and guided to the tumor by magnetic
field for targeted drug delivery. Polyethylene glycol (PEG) technology has
been used to overcome some of the barriers to anticancer drug delivery.
Encapsulating anticancer drugs in liposomes enables targeted drug delivery
to tumor tissues and prevents damage to the normal surrounding tissues.
Monoclonal antibodies can be used for the delivery of anticancer payloads
such as radionucleotides, toxins and chemotherapeutic agents to the
tumors.

**Antisense Therapy**
Antisense therapy is a form of treatment for genetic disorders or infections.
When the genetic sequence of a particular gene is known to be causative
of a particular disease, it is possible to synthesize a strand of nucleic acid
(DNA, RNA or a chemical analogue) that will bind to the messenger RNA
(mRNA) produced by that gene and inactivate it, effectively turning that
gene “off.”

This synthesized nucleic acid is termed an “anti-sense” oligonucleotide
because its base sequence is complementary to the gene’s messenger RNA
(mRNA), which is called the “sense” sequence (so that a sense segment
of mRNA “ 5’-AAGGUU-3’ ” would be blocked by the anti-sense mRNA
segment “ 3’-UUCCAG-5’ ”). Antisense oligonucleotides have been in
clinical trials for cancer for some time now. RNAi has also been applied in
oncology. Small interfering RNAs (siRNAs) can be targeted to tumors and
one example is suppression of H-ras gene expression indicating the potential
for application in therapy of ovarian cancer.