Preface

The'last four decades witnessed unprecedented advances in all branches of science. It is true that basic sciences lead to advance in applied sciences like electricity, electronics, production engineering, chemicals, dyes, drugs and vaccines, to mention a few of particular interest to humanity. Health Science have also made significant advances in diagnostic therapy and prevention of diseases and there by in promotion of health. Time was then we would control the communicable diseases by environmental control measures and protection of individuals by vaccination. Epidemics like Small pox. Plague and Anthrax have been eradicated successfully by systematic application of scientific control measures in the field.

Modern civilization brought prosperity and affluence and in their wake the penalty of affluence such as heart disease, cancer, diabetics and high blood pressure. These diseases are seen less often in the population below the poverty line. This is of affluence claim a large share of mortality and morbidity. We have some knowledge of heart disease, diabetics, high blood pressure as far as their causes, treatment as well as prevention. Change in life style, return to nature in food habits, physical activities and avoidence of habits like smoking and alcohol.

These together with regular physical exercise helps in preveation of heart disease and other metabolic diseases. These changes have been widely accepted by the people of developed countries, thanks to better health education and widespread dissemination of Knowledge of the newer findi-ngs in promotional health activities. The role of National Heart Foundation, Diabetic Society and Cancer Research Foundation in these countries in promoting research, health education and rehabilitation are commendable.

Cancer still eludes a cure. We are still in the dark concerning its cause and hence prevention. Cancer is very prevelant in Kerala forming 12 to 15 percent of inpatient admission to the Medical College Hospitals.

They do not include those seen in the outpatient and amounting to double the number. Cancer in the mouth , cheek, tongue, throat and of the lungs are the commonest among men. In women, cancer of the uterus and breast are common. Epidemiological survey of the population, their habits, food, behaviour, addicitions and life style have definitely shown some interesting causative factors likely to play a role in these diseases. If these could be controlled and eschewed from our life we can prevent some of the major cancer diseases seen in our community. Health education and widespread dissemination of knowledge in this field is urgent.

Dr. A. C. Fernandez has tried in his book to fill up this gap and has made a bold attempt to prescent this difficult problem in his inimitable simple style. Ample scientific references are given. Brief but clear picture of different varieties of cancer are given with its causation and preven-tion The reader gets enlightened but not alarmed. He may even get reassured if the taboos are followed:

Scientific knowledge must disseminate to the society and the public at large. This process of transfer of techno-logy from the laboratory to the field enabled the green revolution by the farmer in our country. Let this book bring a new life style in our society for the prevention of a disease that claims a large share in the mortality and morbidity of our community.

Dr. Fernandez's studies in animals as a toxicologist has broadent his interest in the field of oncology. I wish that this is a forerunner of further publication in promoting interest in scientific knowledge in the field of non formal education. I wish him all success.

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A. C. Fernandez

Contents

INTRODUCTION

Around the world most of the countries are marching forward to A. 0. 2000 through industrialization, agricultural revolution and literacy. Life span is increasing and mortality rate among the new born and the aged people has dropped considerably. Debilitating diseases appear to have come under control. All these have prompted the World Health Organization to aspire health for all at 2000 A. D. History points out that most of the dreaded diseases were brought under control by environmental and personal hygiene along with preventive measures.

Let us see the other side of the picture. Cancer, Stroke, Cardiovascular diseases etc. are on the increase. These degenerative diseases mostly appear in the prime of youth incurring great socio-economic losses to the family and country as well. These diseases have come to be recognized as symbolic to a developed or fast developing country. Among these, one can even note that there is a competition between cardiovascular diseases and cancer for the first place. Recent studies show that death due to cancer is on the increase around the world irrespective of age and economic status. W. H. 0 recently estimated that 2,900,000 new cases occur each year in developed countries and another 3,000,000 in the developing countries. The approximate number of new cases of major cancers diagnosed each year is shown in Fig.1.

In the above circumstances it was felt that it is the need of the hour to increase the awareness of cancer among the public, so that each can do what ever is possible at their level to reduce the chances of getting cancer or to detect it earlier so as to increase the chances of survival.

The United States of America came to understand the magnitude of Cancer only very late. Today in U. S. one out

of every five people dies because of cancer and one out of every four people suffers from cancer at some stage of their life. Now the U. S. A. has taken all possible steps to bring down the on slaught of cancer. Reports submitted by various committees pointed out that contamination of the environment has a major role in the incidence of cancer. Giving due regard to the recommendation of the expert committees, the U. S. Government is enforcing strict measures in keeping the environment clean and to impart necessary education to the public to understand the situation and to make them contribute to this effort by whole-hearted co-operation.

In India the number of people suffering from cancer could be estimated to be more than 1 .5 million. Epidemiclogical studies point out that this disease is on the increase competing with the heart diseases for claiming human life. A developing country like India has many things to her advantage. Learning from the U.S. example she can plan her Industry. Agriculture, Public Health practices etc. so that the water we drink, the air we breathe and the food we consume will not be deleterious to our health.

MALES		FEMALES
Mouth	340000	Mouth, Throat
Esophagus	300000	Isophagus
Lungs	590000	Lungs
	540000	Breast
Stomach	680000	Stomach
Liver	260000	Liver
Colon, Rectum	510000	Colon, Rectum
	460000	Cervix

Fig. 1. Approximate number of new cases of common cancer occurring each year.

COMMON TYPES OF HUMAN CANCER

According to the nature of primary cell type and its pattern of behaviour, the presently known cancers could be grouped into more than, 100 different types. Cancer is a situation where any one cell acquires the distinction of unrestricted proliferation and growing into other tissues, is able to (bequeath) hand over these characteristics to its descendents through countless generations.

Before dealing with different types of cancer we shall try to familiarise some common terms.

A tumor is a swelling or abnormal mass of cells arising from a normal tissue. The word is used often as a synonym for the word neoplasm, meaning new growth. A tumor may be benign (harmless) or malignant (harmful).

A benign tumor consists of a relentlessly multiplying group of cells that do not grow into other tissues and never spread to different and distal parts of the body (metastasise). They tend to grow relatively slow (exceptions are there), appear well encapsulated and to be relatively harmless except for local pressure that may build up and produce discomfort. Most benign tumors carry some risk of eventual malignant transformation and even though the risk is rather small, surgical removal is generally advisable.

A malignant tumor consists of steadily expanding mass of cells that also infiltrate and invade surrounding tissue/ metastasises and unless arrested, eventually overwhelm the patient. (The term cancer refers only to malignant tumors. Though the term benign neoplasm is accepted, the use of terms neoplasia and neoplastic disease is restricted to malignant cancers only). Traditionally malignant tumors are classified into 3 main categories: Carcinomas, Sarcomas and Miscellaneous others, according to their primary cell types and microscopic appearances. If we consider the fundamental behaviour, all cancers are essentially the same.

Carcinomas are malignant tumors that arise from the cells of membranes which form external or internal lining of organs or tissues. It can be either external covering like skin or internal lining such as that of gastro intestinal tract, ductal systems of breast etc. Among malignant cancers about 90% is accounted for by carcinomas and it is postulated that this may be due to easy exposure of these cells to carcinogenic agents. A tumor arising from some glandular structures and which retains some resemblance of glandular formation even in malignancy is known as *Adenocarcinoma.* When a tumor appears so primative in microscopical picture and has not retained its structural organization, it is known as Anaplastic carcinoma. Tumors of squamous epithelium of the skin, oesophagus or of other membranes are known as *squamous cell carcinoma.* These tumors are of moderate malignancy and retains the microscopic characteristics of its tissue of origin. Tumors of the supporting tissues, such as the bony skeleton, cartilage, muscle, fibrous tissue, joint surfaces, fat tissue etc. are known as *Sarcomas,* and comprise of less than 5% of all malignant tumors.

The remaining malignant tumors generally known as miscellaneous tumors arise either from covering membranes of supporting tissues. These miscellaneous tumors, includes a wide variety of tumors. Malignant melanomas of skin, leukemias and lymphomas of the reticuloendothelial system, glioma and meningiomas of the brain and cerebral nervous system etc. are only some examples. These tumors are found to arise from highly differentiated cells from corresponding tissue.

Thus, an understanding of the varied forms of cancer will be of much help to understand the nature of cancers affecting different tissues of human body.

SKIN

There are three main types of cancers of the skin.

(1) *Basal cell carcinoma.* This is known to occur among people living in areas of high solar intensity. Exposure of people to *Ultraviolet radiation* of the sunlight is noted as the cause of this

particular cancer. Commonly it is seen on the face and hands, the most exposed regions of the body. It is an extremely slow growing cancer, eventually ulcerating with a characteristic pearly margin. Though locally spreading it is never known to metastasise. It is curable. This cancer may reoccur later and hence continued *survillance* is essential.

(2) *Squamous cell carcinoma.* Second most common form of skin cancer appear as a raised ulcer with a hard margin which can spread to the next closest lymph node. These occur commonly in the exposed regions of the body. They do occur anywhere in the body but only rarely. It is believed to be caused by local heat, chronic irritation (pipe smokers lips, trumpet players lips). Treatable in early stages. Metastasis is common.

(3) *Malignant melanoma (Malignant pigmented mole).* This cancer can suddenly appear as a new lesion or a previously benign pigmented mole may suddenly turn into a lesion. This also appears to have a causative relationship to sunlight. A highly invasive tumor with early entry into the lympatic and circulatory systems. Treatment depends on the time of diagnosis and extensiveness of the leisions.m

Nasal Sinus. Throat. Pharynx

Tumors arising in nasal sinus, throat and pharynx are relatively rare in comparison with other body sites. These appear in inaccessible sites and infiltrate heavily into neighbouring tissues. Some casual relationship to smoking or to repeated inhalations of toxic fumes of certain industrial chemicals is suggested. A typical cancer of this category occurs in people of equatorial Africa and is popularly known as Burkitts lymphoma. This is a highly malignant one and seen mostly in children. A combination of insect born virus and chronic infestation by malarial parasites are believed to be the causative agents.

Larynx:

Laryngeal cancer appears on the vocal chords. Symptoms appear as hoarsness of voice. Treatable. Few die from laryngeal cancer.

Esophagus:

Occurs commonly in people of Middle East and Turkey. Cancer is supposed to arise against the repeated injury of esophageal lining by the frequent swallowing of very hot drinks by the above said population. In China where methods of grain storage result in a high content of carcinogenic nitrosamine this cancer is reported. In western world it is known as a tale's disease and occurs more in black people when compared to native whites.

Symptoms are difficulty in \ swallowing, sensation of food sticking in the gullet and as the illness progresses swallowing fluids also becomes difficult. Rapid weight loss from starvation settles in.

Conventional treatments are pallative and surviving 5 years after diagnosis is recorded less than 4%. Metastasis positive. (Patient usually dies from starvation rather than metastasis).

Stomach

Symptoms of stomach cancer are an abrupt loss of appetite, and anemia. Even the sight of food becomes nau-seating. Gastric cancers are always carcinomas. Leiomyo-sarcomas do occur but not very often. Both types spread primarily to the regional lymph node and to liver. Curable in early stages. History of atropic gastritis and pernicious anemia may be there. Many causative agents are suggested, such as heavy dependency on smoked, broiled foods which are rich in carcinogenic hydrocarbons, consumption of pickles and foods rich in nitrates, indulging in enjoying delicacies like bracken fern. Etiological factors like history of relatives with stomach cancers is an added risk.

Duodenum and Small Intestine:

Cancer of small Intestine is rare and duodenal cancer is still rare. Recent studies reveal an increasing tempo in the occurence of these cancers. The reduced incidence of this

cancer is attributed to the fast transit time of ingested food with their associated carcinogens, minimizing any local exposure. This cancer usually appears abruptly as an acute intestinal distension with frequent colicky pain. Profuse vomiting-necessitating immediate surgical attention is usually when the diagnosis also made. A variety of histological types of this tumor occurs. Surgery is the first choice in early stage. Radiotherapy is not popular. Chemo-therapy is prefered if the tumor is a sarcoma and is not of much help when it is a carcinoma and have metastased.

Colon and Rectum;

Large intestine or colon cancer is common when com-pared to that of small intestine. This is attributed to the increased contact time to fecal carcinogens. In modern and sophisticated societies food processing techniques take away the indigestable cellulose fibre content, which result in small quantities of stool, and chronic constipation which promotes prolonged contact of colorectal mucosa to carcinogens present in the feacal matter. Irregular bowel movement, anemia, blood with stool etc. are some of the symptoms and these vary with the site of affliction (i. e. in left colon or right colon or transverse colon). Tumor of the right colon appears insiduosly while that of left colon presents more dramaticaliy with metastases. Radio therapy is generally not an accepted treatment. Chemotherapy was found to be useful.

Tumors of the rectum usually grow in the distensible part of the lower bowel. Obstructive symptoms are not common. Bowel irregularity, blood in feaces, constant urge to defecate together with tenesmus (a sensation of conti-nuous contraction and expansion) are reported. A bulky tumor will give the feeling of incomplete bowel evacuation. Metastasis are common in the liver.

Cancer of the anus is usually squamous carcinoma and like similar tumors elsewhere, it can well be cured by radio-therapy.

Pancreas

Cancer can appear at the head or body of the pancreas. Cancer affecting the head is predominantly seen in elders and slowly squeezes the bile duct passing through the head, giving rise to obstructive jaundice. It can metastasise to adjacent lymphnodes and then to liver. Cancer of the body of pancreas is very much difficult to diagnose due to lack of (Specific) characteristic symptoms. Diminishing appetite and loss of weight with constant abdominal discomfort, and backache are common. It is considered to be difficult to treat.

Gall Bladder

Cancer of gall bladder is relatively rare. Recently it has been related to nutritional and to use of some hormones. At an early stage this cancer is treatable. Later after infiltration into the adjacent liver tissues cure become, impossible.

Liver

Liver cancer was considered characteristic of developing countries. The cause assigned was chronic liver damage from continuous protein starvation. Now a days liver cancer is prevalent in western countries also. Here alcohol and certain industrial or laboratory chemicals are noted as causative agents. A rare form of primary liver cancer arising among workers exposed to vinyl chloride monomer is a true example. In only very rare instances is a primary liver cancer so situated and so localized that its surgical removal is possible. The liver is by far the most common site of secondary metastasic tumors spreading from primaries elsewhere particularly primary tumors of the gastrointestinal system.

Kidney

Two different types of cancers are reported affecting the kidney: (1) *Transitionalcell carcinoma, a* rare type of tumor and may arise anywhere in the endothelial lining of the kidney, ureter or bladder. If the malignancy is confined to one place surgery is the treatment of choice. (2) *Adenocarcinoma.* This is also known

as hyper nephroma. This shows a moderate growth rate and generally occurs in mid-dle aged or elderly people. Classical symptoms are hematuria with or without some discomfort in the affected groin. In undiagnosed cases, the disease progresses as the tumor enters renal vein. Widespread skeletal and pulmonary metastases does occur.

Renal carcinomas demonstrates some special characteri-stics. The primary nodule in the kidney may not metastase. But in majority of instances metastases located in (distant places) some other site may indicate that many maybe present. Other times a symptomless and unnoticed renal tumor, may show up as secondaries either in brain, bone, lung or in many places simultaneously. Only microscopical examination of the tumor can establish correct diagnosis. There are also records to show that removal of the primary tumor in the presence of known metastases has resulted in complete remission and disappearances of the metastases.

Urinary Bladder

Cancer may be present in many shapes. It can be benign warts, leisions which are malignant or ulcerating and invasive tumors of good size, all arising from the bladder lining. Symptoms are haematuria, increased frequency and an urge to urinate and finally pain lingers. Early diagnosis helps in treating effectively by surgery and radiotherapy. Bladder cancer is relatively slow growing and usually shows a progress from benign to malignant type over a period of ye-ars. Symptoms appear as a result of local infilteration and growth in size rather than metastases. The link between exposure to certain industrial chemicals and the occurence of bladder cancer is well known. Other agents held respon-sible for higher incidence are heavy smoking; consumption of coffee and some inborn error in tryptophane enzyme metabolism.

Prostate Gland

Prostate is a (reproductive) gland surrounding the urinary bladder neck in males. Enlargement of this gland is a

common accompaniment of the aglhg process and ninetynine percent benign. The benign enlargment while growing steadily with years may turn malignant. The early symptoms of undue enlargment are obstruction to voiding of Urine, increased frequency of urination necessiating urination during night and a feeling of incomplete emptying of bladder. Treatment is by surgery, hormones, radiotherapy or chemotherapy.

Testicles

There are two rriain type Of testicular tufnors: semlnOrhas arid teratomas. They do grow rapidly and occur in younger males. It is noted that tumors appear more commonly in males with shrunken or undeccended testicles and with fertility disorders. Early notable eymptom is the steady enlargement of the affected testicle. If hot diagnosed early aid treatment undergone tumor may spread to lungs and other parts of the body. Previously considered to be untreatable. At present good results are recorded with chemo-therapy.

Ovary

Tumors of ovary are many, some benign and others malignant. Many of these tumors are cystic in nature (form-ing a cavity in the centre) and grow rapidly in size. But it should be noted that shear size does not bear any relation-ship with malignancy, the initial symptoms may be no more than an increasing abdominal distension or may arise from pressure on adjacent pelvic organs, giving rise to bladder and bowel irregularities and a bearing down sensation, these may spread to liver and abdominal cavity producing a massive accumulation of fluid, “ascites”. The treatment of choice at initial stages is removal of tumor, womb and the ovaries. Depending upon the precise histology some ovarian cancers show a good response to radiotherapy and chemotherapy. Advanced cases with recurrent, tense ascites requirs repeated aspirations of the dscitic fluid for patient comfort. Some retardation ban be anticipated by intraperitoneal injection of cytotoxic drugs.

Uterine Cancer

This is, also known as endprnetrial cancer. Cancer of the body of the uterus is most common in women around menopause. The precise cause is unknown. Likely to be related to history of hormonal use for contraception purposes but debatable. Endometrial cancer makes its presence known by menstural irregularity.post menopausal bleeding and abnormally heavy menstural periods. Surgery along with hormonal therapy is generally given Cancer can occur at the neck of the uterus, known as cervix. lt rarely occurs in unmarried woman and incidence increases as the age at first intercourse decreases. It is less seen among group of people where males practice circumcision. This condition could be (detected) diagnosed by analysing a cervical smear namely pap smear Cancer of the cervix, like most other deep pelvic cancers, tend to grow comparatively slow and to cause more havoc and distress by local infiltration than by distant metastases. In advanced cases bladder and rectal tissue also may get involved. A full gynaecological examination and a cone biopsy of the cervix is usually followed before confirmation.

Lung cancer may appear suddenly in people who are in apparent good health, more in their late fjfties. Symptoms are very vague with chronic cough, spitting up of blood, increasing breathlessness and sharp weight loss. Another presentation can be by way of pneumonia or pleurisy, that fails to respond to treatment. Very often first indication of this disease is some metastasic manifestation as bone pain, hoarsness in larynx, headache for brain metastasis. The diagnosis is usually very obvious, one simple chest x-ray and of any doubt supported by bronchoscopy and biopsy. A cancer of the pleura! covering of the lung is known as mesothelioma.This is a rare form of cancer, which can also arise from peritoneal lining of the abdomen and is usually associated with exposure to *asbestos.* This particular form is considered untreatable and pursues a brisk downhill course, Treatment of late cancers that have invaded vital structures of respiratory organs is most unsatisfactory. In late cases surfacing at old age survival time from the date of

diagnosis till the date of death is usually measurable in months.

Breasts

Cancer of the breast is most common in women. It occurs more in spinsters than in married women. Another way, it is more common in those who have never lactated and least common in those who have breast fed a number of children. Ir can occur at any age, recording a peak around menopause. It starts as a painless lump in the breast, later dimpling of the overlying skin and retraction of the nipple". This spreads to the axillary lymph nodes and some-times to the intrathoracic lymph nodes and eventually blood borne dissemination, predominantly to the skeleton and to the lung. It is considered to be a slow growing tumor. A patient with breast cancer confined to the breast (not metastasized) has an excellent chance of long term survival, but should undergo periodic examination for recurrence. Approximately one in every hundred breast cancers occur in men (western countries). Symptoms and methods of treatment are the same. The outcome of the treatment in men is unpredictable or poor because of the likeli hood of early metastases.

SUPPORTING TISSUES

Bone tumors:

As mentioned earlier they are of different types and called sarcomas in general.

Osteogenie Sarcoma

Growing ends of long bones are the common site of occurrence and are highly malignant. Most common site is knee. Exact cause is not known so far. Some local injury at the site of incidence is generally seen recorded in case sheets proceeding the onset of the tumor. The tumor arises as a local, painfully expanding swelling in the vicinity of the joint and unless arrested, rapidly spreads through blood stream, principally to the lungs. Although treatment schedules have advanced very much and

promising, osteogenic sarcomas still remain the most difficult to cure.

Fwings Sarcoma is a rapidly expanding bone tumor. Occurs in children and young teenagers but of rare nature. There is some doubt about the originality or distinct nature of this tumor since many of these cases finally appear to be secondaries metastasized from an unsuspected or silent primary neurobfastoma. Treatment is by local radiotherapy, and systemic chemotherapy. Cure rate is reported to be high.

Chondroma is a tumor of cartilage often arising in childhood. They grow slowly throughout adult life and Usually attain large size and are benign. As time passess a high percentage of these benign tumors may turn malig-nant with a spurt in growth and metastase through blood. Rare incidence happens well into adult life and common primary sites are thoracic cage or the pelvis. Once malig-nant, such tumors are untreatable.

Synoviosarcoma are extremely rare and malignant tumors originating from the surface of the joints. Knee joint is the most commonly involved. These occur from childhood to any age and metastase into lungs. Radiotherapy and chemotherapy are now preferred to amputation. Success is unpredictable.

Myoma are tumors of the muscle tissue, and different types are known. When they appear in uterus and multiple in nature they are called *fibroid.* Maligant changes in myoma are rare but well known. Malignant muscle tumors are called leiomyosarcomas when they arise from the unstriated involuntary muscles (gastro intestinal tract, uterus, urinary tract etc.) and rhabdomyo sarcomas when they originate in the striated voluntary muscles of the musculoskeletal system. If accessible the treatment is by surgery. Radiotherapy and chemotherapy are of limited value.

Fibrosercoma: This is a rare type of tumor arising from fibroblasts of connective tissue. Both benign and malignant types occur. Mostly they arise at sites of intense fibrobla stic activity such as healed wounds, scars and surrounding chronic and

discharging sinuses. It is also common in body sites which could have undergone radiotherapy for some kind of malignancy. Treatment varies with site, type of cells involved. Radiotherapy and chemotherapy found useful.

Lipoma: These are very slow growing and very common benign tumors of the adipose cells at the subcutaneous sites. These occur in multiple and rarely undergo malignant changes. When they become malignant, it is differentiated by the brisk growth, ulceration and metastases. Effective approach is, the removal of lipoma irrespective of its benign nature.

Spindle cell sarcoma: These are rapidly growing types of tumor and very much undifferentiated in nature, making final diagnosis by microscopy difficult. It can arise anywhere in the body and is highly malignant. Responds to Radio-therapy and chemotherapy.

Lymphatic system: Lymphatic system consists of wide spread body system draining into innumerable lymphnodes and spleen. This is the system which is active in every living body in its fight against cancer. Some of the consti-tuent cells of the lymphatic system turn malignant and may range from benign follicular lymphoma to malignant lymphosarcoma, Hodgkins disease, and reticlum cell sarcoma at the other end. Because of the extensive nature of the lymphatic system and high proliferating capacity of these lymphocyte forming cells, malignant forms spread widely and rapidly throughout the body. When these cells join the blood stream, they are identified as acute or chronic lymphatic leukemia according to its nature. Benign follicular lymphoma presents itself as a painless enlargement of a closely related group of lymph glands, Surgical removal followed by radiotherapy and chemotherapy is the treatment of choice Some time ago this was considered to be a fatal cancer. Now enjoys a high rate of cure.

Causes of lymphatic cancer is unknown. It is suggested that some infectious agent or carcinogenic agent may be the root cause'. This suggestion came out of the fact that these

cases appear iri clusters in particular locations or streets in certain towns. Another cause attributed is the exposure to excessive high energy radiation of special group of people such as radiologists, dentists, offsprings of mothers who had abdominal X-rays during pregnancy, atombomb survivors, employees of nuclear industry, patients taking immunosuppresant drugs after organ transplantation etc.

Blood Forming Organs : Leukemia is a from of maligna-ncy in which enormous numbers of white blood cells appear in the blood circulation. Two different types occur commonly and are known as lymphatic and myeloid.

Lymphatic leukemia arises from a primary malignancy of the lymphatic system and the circulating blood contains an Immense number of lymphocytes. Myeloid leukemia arises from the leukocyte forming myeloid cells of the bone marrow and is distinguished by a greater number of granulocytes in free circulation with premature blast cells. Each category is further divided into acute and chronic depending upon the malignancy. Symptoms of the leukemia are increasing lassitude, anemia, case of bruising, susceptibility of infection, loss of Weight, night sweats, splenic and often liver enlargement and in the case of lym-phatic leukemiapalpable enlargement of numerous lymphglands. The diagnosis could be made by a simple differential blobd count. Some years back the acute lymphatic leuke-mia of childhood and chronic myeloid leukemia of adulthood stood ho chance of survival, today chemotherapy combined with radiotherapy promises cure to a high percentage of the victims.

Polycythemia vara is a rare type of cancer affecting the bone marrow cells responsible for production of red blood cells. In this cancer tbere is an abnormal increase in the number of red blood cells. Blood letting and use of radioisotopes are the usual course of treatment.

Multiple Myeloma: Is cancer of the plasma cells of the bone marrow concerned with the production of immunoglobulins, It is more common in men than in women in the later years. These

tumor cells produce an abnormal immuno-globulin that can be detected in blood and also in urine. Kidney failure is a possible complication, an end result of blockage of tubles by this abnormal protein. The illness is reported to run a variable course but tha usual picture is that of multiple painful expanding leisions of the skull and skeleton. Treatment is by radiotherapy and chemotherapy.

Brain

Tumors of the brain may be benign or malignant. The rigid nature of the skull becomes a barrier for growth and expansion of any site, irrespective of its benign or malignant nature. (The sites which start growing lead to compression of brain tissue and this result in various other anomalies). There are two major types that cover the brain tumors. *Meningiomas* arise from the membranes that cover the brain and *gliomas* arising from the brain cells. Gliomas are again classified into astrocytornas, oligodendrocytomas and medulloblastomas according to primary cell type. It can be summarised that all these can arise as benign, slow growing and well encapsulated or highly malignant, fast growing and diffusely infiltrative. The first one permitting clean surgical removal and later one a surgical *dilemma.* Radio-therapy is known to give considerable palliation and even occasional cure. These can occur at any age but common in children upto 10 years and older people from 50 and above No clear evidence of a causative agent is known. It is related to earlier head injuries and increasing headache and interference of some brain functions are proposed to be some of the symptoms.

Choriocarcinoma:

In every pregnancy cells of the newly formed embryo form a *placenta* and *invade* tne lining of the maternal uterus to obtain blood and nutrient supply for the developing foetus. Cancer occurs generally after a spontaneous abor-tion of the foetus and ordinarilly happens after abortions of grossly deformed foetus. It is thought that some of the embryonic placenta! cells remain inside the wall of the uterus even after abortion and assume all the characteri-stics of an

independent and highly aggressive tumor Diagnosis is by a hormone test and chemotherapy is the treatment of choice.

Embryonic tumors:

Nephroblastomas (Wilm's tumor) of the kidney, retinoblastomas of the eye, medulloblastomas of brain, neuroblastomas of sympathetic nervous system, rhabdosarcomas of pelvic organs, hepatoblastomas of the liver etc. are some representative example of embryonic tumors. When cells from various embryonic organs go out of control tumors of this sort occurs. These are ususlly seen in young ones, and are extremely invasive in nature. Occassionally these cells lie dormant in earlier years and present themselves only in later years. Surgery, radiotherapy, chemotherapy etc. are employed according to the nature of the case.

Teratomas are tumors of varying grades of malignancy and contain a mixture of various tissues in different grades of differentiation. Therefore a relatively benign teratoma of the ovary may contain structures like teeth, hair, skin etc where as a malignant teratoma of testes may only contain a solid fleshymass, which under microscope may be seen to contain representative cells of many other tissues. Such evidences support the view that a teratoma is a suppressed twin growing with in the tissue of the survivor. These can occur at any age and are mostly confined to ovary or testes. Many have questioned its origin to be malignant degenera-tion of germ cells. Symptoms vary with the site. Surgery and chemotherapy are used accordingly.

CAUSES OF CANCER

Studies on the statistics of cancer mortality show that every minute more than one die of cancer. Most of them die miserably, some even without knowing that they suffer from and die of cancer. This naturally raises the question what causes cancer ?

If we go through the literature on cancer we can see that there is no single answer to the above question. Cancer grew up with civilization, industrialization and prosperity. It can be noted that majority of the human cancers are man made because of the carelessness of people in keeping the environment clean

and uncontaminated.

Cancer is very common in the poor and the rich alike. You may hear that so and so is having cancer. You can not believe it, yet it is true, that the young man is having bone cancer. After some time you come to know that the legs of the poor fellow is amputated, with a promise of extended period of life. But before the patient learns to move around in crutches the news comes that he is dead. That is cancer, so silent, so devastating and so cunning. Now again the question arises what was the cause ??

Credit goes to Sir. Percival pott, a British Surgeon who in 1775 identified the scrotal enlargment sickness of the chimmney sweepers to be a cancer. He attributed its origin to the lodging of soot in the skin folds of the scrotum. This could be considered to be an example of occupational cancer. Following this, many such examples of occupational cancer came to light. “Mule spinners cancer” among the dye industrial workers, pleura! and peritoneal cancers of asbestos workers, are characteristic examples of occup-ational cancers. High incidence of cancers seen among wor-kers in printing industry (carbon blaok), workers in dry cleaning industry (carbon tetrachloride), roofing workers (benzopyrene), paper mill workers (polychlorobiphenyl), workers in the plastic industries (vinyl coloride monomer), workers in the rubber industries (nitrosamines) are some more examples of occupational cancer. These examples also clearly point out the role of chemicals in the increased inci-dence of cancers. Many scientists and physicians who wor-ked with the development and use of X-rays during the first two decades after its discovery died only of cancer. Further, the radioactive atomic nuclei like strontium 90, cesium 137, carbon 14 and others liberated into the atmosphere by the test explosions of nuclear weapons are now known to be absorbed into soil, plants and animals. These also may contribute to the general incidence of cancer.

Let us go back hundred years at least, and see what our forefathers were doing? How they were interacting with nature? They got up early in the morning, walked quite a distance to complete morning ablutions and prayers. Carbon black, plant

leaves and stems were used to clean the teeth. Used only grains and vegetables grown out on local fields. Only composite manure was used. Men, women, children all were engaged and busy with day today family affairs. Whatever item was needed for the maintenance of human life was made out of natural materials only. Cooking was mostly done in a place away from the residence and oils trom seed were used to light lamps. House was constructed with materials available in nature like, leaves, woods, climbers, mud etc. Other than pickling food preservation was not practiced very much. Drugs, were prepared from plants. Water for drinking and cooking was drawn from well kept ponds or wells. Life was very calm, labour inten-sive but with lot of leisure and there was no dearth of materials needed for day to day life.

Now, we rise with a tired body. Use tooth paste and chlorinated water. Synthetically lathered soaps and flavo-ured hair oils are used. We mask ourselves behind creams and powders. After liberal use of deodarants along with sprayed clothes we are ready for breakfast and the day's work. We eat grains and vegetables grown with artificial manures and protected by pesticides. Food is cooked in metal utensils and in scorching heat at a faster rate than olden days. Kerosene and cooking gas is used fer cooking food. We always eat in a hurry. We stitch dressess using

synthetic materials which may not absorb sweater permit gas exchange and may even cause itching and skin allergy. Shelters are constructed with cement and asbestos which raise lot of dust. Household furniture may be made out of polyurethane foam, P. V. C. leather and tiles which may leach out'chemicals into the house environment. Use of detergents for washing and chemicals for mosquito and fly control with in the microenvironment of the living space has become a fashion. The use of petrol and diesel for transportation, congested atmosphere in various office buildings along with cigarette smoke, the chemical smells emanating from copying machines, correcting fluids, carbon papers etc. add to the already polluted atmosphere of the urban air.

Just compare the past with the present and the preponderance of chemicals in modern living will stand out. Why cite more, even in the most private affair in one's life, like sex, one can see hundreds of chemicals in use. This illustration was drawn to project the influence of chemicalswhich may be the cause for many of man's illness may be even for some of the cancers too.

Major studies have been completed on selected topics which are believed to play major roles in the incidence of cancer. Some of them will be briefly discussed below.

Environment & Cancer

Experts take the view that 30% of all the cancers are due to environment, alcohol and life style. Today the environment is highly contaminated by many substances either synthetic chemicals or naturally occuring substances. Many of these are known to be carcinogenic in experimental animals.

The environment could be described as a unit made up of the air we breathe, the food we consume and the water we drink.

Air supply us the oxygen we need to keep our life on. Today, air in the atmosphere is known to be contaminated with a number of materials emanating from tobacco smoke, kitchen fires, automobile exhausts, industrial smoke stacks' incineration of waste materials, power generating stations run by nuclear power or coal burning, pesticides, fertilizers, synthetic and cosmetic

sprays, deodarants, etc. Some of the very common contaminants seen in the air is given in table one.

TABLE I

SOME RECOGNIZED AND SUSPECT CARCINOGENS THAT MAY OCCUR IN THE AIR WE BREATH

Cacinogenic chemicals	Source from
Benz (a) anthracene Benzo (a) pyrene Dibenzo (a. h) pyrene Benzo (b) fluoranthene Beozo (j) fluoranthene Indeno (1, 2, 3-ed) pyrene	Combustian products & Cigarette smoke
Arsenic	Pesticide use
Asbestos	Asbestos Products.
Cadmium Chromate (hexavalent)	Mining and smelting
DDT Aldrin Dieldrin Heptachlor Lindane	Pesticide application
Carbontetrachloride	Industrial effluent
Vinylchloride	Industrial effluent

Data from Advances in Modern Toxicology Vol. 3. H. F. KRAYBIL

Water form another important factor in maintaining life process. Drinking water is collected and made pottable before supplied to the public for consumption. The advent of chemicals have polluted every source of water to an extent. For example the rain water is acidified and contami-nated by the polluted atmospheric air. Rivers and streams gets contaminated by the

carelessness of man by permitting the industrial effluents to be discharged into them. Ground water reservoirs are known to get contaminated by burried municipal, industrial or nuclear waste materials. Conta-mination of water has gone to the extent that in developed countries drinking water ready for supply is screened for carcinogens like, dihaloacetonitriles, trihalomethanes etc. which may occur as a result of disinfection by chlorination. Table 2 shows possible contaminants of water.

Food, gets contaminated very easily in the present world. Agriculture has become intensive with the use of synthetic fertilizers, pesticides, weedicides etc. Agricul-tural products are stored and protected by chemical sprays and fumigents. Food is mechanically processed and packed ready for consumption. The above processes involve the use of number of chemicals as preservatives, fillers, soft-eners, flavouring agents, colourants etc. Delicacies like ice-creams, jellies, soft drinks etc. are other sources through which chemicals get into the body. Diet, nutrition and its relation with cancer has been subjected to extensive studies for the last 15 years. Food and cancer is discussed in detail.

Food and Cancer

Nature and type of food may be directly related to the production of cancer': is a recent theme forwarded by Scie-ntists working on the causes of cancer, especially those in United States of America. One out of every five Americans dies of cancer and one out of every four Americans suffers from cancer at least once in their life time. It is reported that about 35% of the all known cancers occur due to the carcinogens contained in various food items or due to the carcinogens formed during the cooking of food. From the time of birth, the procession of food and hence carcinogens starts passing through the alimentary system. We would have finished 20,000 break fasts,20,000 lunches and 20,000 dinners as we reach 61. Coffee, Tea, Soft drinks, Alcohol, Icecreams, Snacks etc. will have to be counted extra.

TABLE - II

SOME RECOGNIZED AND SUSPECTED CARCINOGENS THAT MAY BE FOUND IN RAW AND POTABLE WATER

Recognized		Suspect
Arsenic	Dihaloacetonitrile	Dieldrin
Benzidine	Benzene	Heptachlor
Dibenz (a, h) anthracene	Chlordane	Chrysene
Vinyl chloride	Heptachlor epoxide	1, 2-Benzanthracene
Carbon tetrachloride	Cadmium	Chromium (hexavalent)
Chloromethyl methyl ether	DDE	DOT
Asbestos	BHC (Lindane)	Chlorodibromethane
3, 4-Benzpyrene	Mirex	Chloromethyl Ethyl ether
1,2,7, 8-Dibenzanthracene	Polyurethane	Benzene hexachloride
Ethylene thiourea Bis (chJoroethyl) ether Tricolor oethylene		

Data from Advances in Modern Toxicology Vol. 3 H. F. KRAYBIL

Do food really can cause cancer? You cannot get ayes or no answer. But research on reports of cancer coming from various parts of the world show that if we are going to compare two nations there is substantial difference in the rate of cancer occurrence. The type of food and nature of preparation was entirely different from one country to another. For example, the rate of stomach cancer is very high and that of lung, breast and intestinal cancers very low in Japan while in U. S. lung, breast and intestinal cancers were occuring at higher rate and stomach cancers at a lower rate. Even when smoking and drinking were exc-luded as common factors, there was gross difference in the type of food used in both countries. A detailed analysis of the above data showed that there is a clear cut correlation with the type and nature of food and the incidence of vari-ous cancers. With this in mind further studies were carried out on Japanese people who had migrated to U.S.A. in their younger days. The results showed that the nature and type of cancer seen in this selected population was similar to that of U.S. citizens. This report was epochal in postu-lating the theory that there is a definite correlation between diet and cancer. Epidemiological studies that followed brought supporting evidence for this theory.:

The occurrance of intestinal cancers in U.S. is related to the consumption of a high fat diet. Further, higher rate of bile acid production noted in this population is also supposed to promote the formation of intestinal cancers. Studies are underway to determine whether this excess secretion of acids is due to the high intake of fat foods. The high rate stomach cancers seen in Japanese people is related to the lavish use of salted pickles. High salt content from these may be continuously destroying the epithelial lining of the stomach wall. The nitrosamides like chemilals reaching the stomach through the diet may react constantey with the exposed stomach wall and may cause stomach cancer. To test this hypothesis, stomach cancer in Chinese people were also studied since they are known for regular use of pickles in large quantities. This study revealed that mycotoxins occur in Chinese pickles as a con-taminant. Mycotoxin is a carcinogen in animals and hence

stuides are under way to further sort out the role of salt in the incidence of stomach cancers. But there are studies to show that generally a reduction in salt intake is capable of bringing down the rate of incidence of stomach cancer. A diet of high fat content is reported to be one of the possible causative factor for breast and intestinal cancers in U.S.A. Reports on the work carried out by Newmark and Wargovich supports the above thesis but points out that some fatty acid are also involved along with bile acids in promoting the intestinal cancers.

When we consider the above facts, no definite answer has become available. But if we take note of the results of the epidemiological studies showing correlations between diet and cancer and also take into consideration circumst-antial evidences from reports comming from all over the world, we may well say that diet can atleast act as a pro-moter of cancer.

Now it is known that diet can contain numerous chemi-cals that are well known carcinogens. Some of these carci-nogens are capable of inducing cancer in experimental animals (Table 3). the present question is whether these carcinogens do play an active role in the formation of cancers that occur in human beings?

Some of the plants, used for human consumption are known to produce toxins to keep away bacteria, fungus and insects from attacking them (Table 4). This character is noted by the scientists and some of them are isolated. But studies on their toxic potentials are not available. Other than these, aflotoxin and mycotoxin are examples of fungi that attack grains, especially when stored. Aflotoxin and mycotoxin are proven to be carcinogenic in experimental animals. 0. 0. T. and polybrominated biphenyl are insecti-cides used in agriculture and are known carcinogens in experimental animals. Hormonal residues like stilbesterol found in meat products, saccharin, butylated hydroxamisole, carragen etc. found in cooked and tinned food products, nitrites found in pickles and tinned meat, trihalomethanes, chloramines, dihaloacetonitriles found in chlorinated drinking water etc. are proven to be carcino-gens

in experimental animals. Here we get a general picture of how we may get exposed to various carcinogenic agents through food and water.

FOOD BORNE CARCINOGENS

1. **Naturally occuring:**
   Mycotoxin
   Aflotoxin
   Ochratoxin-A
   Luteoskyein
   Actinomycin-D
   Senkrikine
   Monocrotaline
   Petasitenine
   Cycasin
   Safrole

2. ***As contaminants:***
   Polybrominated biphinyl
   Diethyl stil besterol.

3. ***Additives:***
   Saccharin
   Butylated hydroxyi anisole
   Carragen
   Butylated hydroxyltoluene

4. Polycyclic aromatic hydrocarbon
   Nitrosamine
   Nitrates

TABLE - 4

TOXINS PRESENT IN PLANT PRODUCTS

Plant products	Toxins
Black pepper	Agaritine
Potato	Solanine
Cocoa Powder	Theobromine
Tea leaf	Theobromine
Honey	Pyrrolizidine
Lupine peas	Angyrine
Coffee beads	Cofferin, chlorogenic acid
Mustard oil	Allybiothioeyan
Cottonseed oil	Gossypol

What happens to the carcinogens naturally occurring in the food on cooking? Will cooking will permit the form-ation of new carcinogens in food? These are the two questions for which answers are being investigated in the Loren's Liver More National Laboratory of U. S. A. Pre-liminary studies have shown that nature and type of cooking, the temperature and exposure to air while cook-ing etc. can have some influence on the number and type of carcinogen or mutagen produced while cooking. Table 5 shows some foods that may give rise to mutagen or carcinogen on cooking and cooking methods that will give rise to more carcinogens.

Anticarcinogens:

Studies on the carcinogens present in the food also brought out the presence of anticarcinogens in food. Vitamin E generally known as Tochopherol protects DNA from the oxidative process initiated by the carcinogens. Carrotene which is available in some vegetables are known to protect lipid

and fat cell membranes from oxidative damages. It is also postulated that selenium (selenite) is able to counteract the carcinogenic chemicals. Phenol, glutathion, ascorbic acid etc. are other antioxidants which are found to neutralize or make ineffective many of the carcinogens.

TABLE - 5

MUTAGENS IN COOKED FOOD AND METHODS OF COOKING GIVEN IN ASCENDING ORDER

+ Beef	Frying
Pork / Ham	Broiling
Lamb	Canning
Chicken	Baking
Eggs	Boiling
Fish, Beans	Microwave
— Cheese	

\+ Maximum
\- Minimum

Most of the studies on the relationship between food and cancer were sponsored by U.S.A. and WORLD HEALTH ORGANIZATION. These studies, though they do not prove positively that food can cause cancer, they do show that food can act as a promoter in the induction of cancer, as it contains a number of carcinogens and mutagens. We may be able to draw a correlation between type of cancer, geographic location and nature of diet (Table 6) from the above studies. Many suggestions to reduce the risk of cancer from diet were also in the above studies. Use of freezers to preserve food so as to reduce the use of preservatives; to make vegetlabes and fruits available through out the year; increase the quantity of vegetables, fruits and grains that contain fibers in daily diet which will give material for reacting with the carcinogens in the diet and thus will ensure adequate emptying of stools enabling the maintenance of a clean surface in the intestinal

canal and rectum. A study carried out by the National cancer Institute (NCI) estimated that 100 lakhs people will become cancer patients in late 1990. This postulation prompted NCI* to set up a National Research Council Committee on Diet, Nutrition and Ganger. This committee came out with an interim report by the end of the year 1982. This report contained some guidelines that were formed after detailed considerarion of so far available data on diet, nutrition and cancer. These are:

1. Reduction of fat intake to not more than 30 % of total calories.
2. 'Inclusion of fruits, vegetables and whole grain and cereal products in daily diet'.
3. 'Consumption of foods preserved by salting or smoking minimized'.
4. 'Carcinogenic contaminants minimized and maximum permissible limits established. Additives evaluated for carcinogenicity before approval'.
5. 'Further identification and carcinogenicity testing of dietary mutagens and legislation to get their levels minimized'.
6. 'Moderate consumption of alcoholic beverages.'
7. 'Recommendations for education on diet and cancer for seeking co-operation of the food industry and for reviewing guidelines each five years'.

We have seen a variety of possibilities by which diet can be linked with cancer. Lack of proof is not a justifica-tion when the number of people affected with cancer is on the increase in millions by an year. Therefore, if we can save even one percent from among the total cancer popula-tion by adjusting and controlling diet and nutrition, why not we start doing something about it ? Moreover, looking back in history we see, man has conquered many dreadful diseases not by treating but by prevention.

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* National Cancer Institute U.S.A.

TABLE - 6

COMMON CANCERS, DIET AND NUTRITION - A BIRDS EYE VIEW

Sl. No	Site	Places of common occurrences	Postulated circumstances that may Promote cancer formation	Inhibit cancer formation
1.	Oesophagus	Middle yeast, Iran, Central Asia, China, East & South Africa, Normandy & Britany in France	Alcohol-Cigarettes, Low intake of pulses, green vegetables, fruits, vitamin A & C, Riborflavin zinc deficiency.	Avoid drinking & smoking, increased intake of fruits, vegetables, vitamin A & C and Riboflavin.
2.	Stomach	South America, Japan, China, Israel, Island, Minnessota & Michigan in U. S. A.	Use of salted, dried/ smoked high fat meat, salted pickles tinned foods, reduced intake of vege-tables.	Controlled use of salted fried/smoked high fat meat, salted pickles. Tinned foods. High intake of vegetables, fruits, tonned milk.
3.	Liver	Subsaharan Africa, South east Asia, Thailand,China, Taiwan.	Alcohol, Aflotoxin contaminated foods. Infection with Hepatitis B virus.	Avoid alcohol and aflotoxin contamination of diet. Environmental Hygiene, clean & properly cooked foods.

Sl. No	Site	Places of common occurrences	Postulated circumstances that may Promote cancer formation	Inhibit cancer formation
4.	Colon & Rectum	Urban centers of U.S.A, Scotland, Japan, England,	Use of pork & fried, broiled meat or fish. High fat diet-Bile acids in excess.	Avoid fatty diet & western cooking methods. High intake of leafy vegetables, tonned milk. Reduce weight.
5.	Breast	U.S.A. Hawai	Pork & high fat meat and dairy products, cheese, untonned milk, sweets and delicacies.	Reduce high fat meat & dairy products, use fiber containing vegetables tonned milk etc.

TABLE - 7

PROVEN AND PROBABLE CARCINOGENIC CHEMICALS

A. Substance / technological processes that are known to be carcinogenic

1. 4-Amino biphenyl
2. Arsenic & certain compounds
3. Auramine manufacture
4. Benzene
5. Benzidine
6. N, N-bis (2-chloroethyl)-2-naphthylamine (chlornaphazine)
7. Bis (chloromethyl) ether (BCME) & chloromethyl methyl ether (CMME)
8. Chlorambucil
9. Chromium & certain compounds
10. Cocke oven emissions
11. Cyclophosphamide
12. Diethylstilbestrol (DES)
13. Hematite mining
14. Isopropyl alcohol (strong acid metod)
15. Melphalan
16. Mustard gas
17. 2-Naphthylamine
18. Nickel refining
19. Soots, tars and mineral oil
20. Thorium dioxide
21. Vinyl chloride

B. Substances that are reasonably anticipated to be carcinogens

1. 2-Acetylamino fluorene
2. Acrylonitrile
3. Aflotoxins
4. 2-Aminoanthraquinone
5. 1-Amino-2-methyl anthraquinone
6. Amitrole
7. 0-anisidine and 0-anisidine hydrochloride
8. Aramite
9. Benz (a) anthracene

10. Benzo (b) fluoranthene
11. Benzo (a) pyrene
12. Beryllium & its compounds
13. Cadmium & compounds
14. Carbon tetrachloride
15. Chloroform
16. P-cresidine
17. Cupferron
18. Cycasin
19. 2, 4-Diaminoanisole sulfate
20. 2, 4-Diaminotoluene
21. Dibenz (a, h) acridine
22. Dibenz (a, j) acridine
23. Dibenz (a, h) anthracene
24. 7 H-Dibenzo (c, g) carbazole
25. Dibenzo (a, h) pyrene
26. Dibenzo (a, i) pyrene
27. 1, 2, Bibromo-3-cloropropane (DBCP)
28. 1, 2, Dibromoethane (EDS)
29. 3, 3, Dichlorobenzidine
30. 1, 2-Dichloroethane (EDC)
31. Diepoxy butane
32. Di (2-ethylhexyl) phthalate
33. 3-3-Dimethoxybenzidine
34. 4-Dimethylcarbamoyl chloride
35. Dimethyl sulphate
36. 1-4-Dioxane
37. Direct Black 38
38. Direct Blue-6
39. Ethylene thiourea
40. Formaldehyde
41. Hexachlorobenzene
42. Hydrazine and hydrazine sulphate
43. Hydrazobenzene
44. Indeno (1, *2,* 3-ed) pyrene
45. Iron dextran complex
46. Kepone (chlordecone)
47. Lead acetate & Lead phosphate
48. Lindane and other hexachlorocyclohexane isomers.
49. 4, 4-Methylenebis (2-chloroaniline) (MOCA)
50. 4, 4-Methylenebis (n-n-dimethyl) benzenamine.
51. Michler's ketone

52. Mirex
53. Nickel and certain compounds
54. Nitrilotriacetic acid
55. Nitro-o-anisidine
56. Nitrofen
57. N-Nitrosodi-n-butylamine
58. N-Nitrosodiethanolamine
58. N-Nitrosodiethylamine
60. N-Nitrosodimethylamine
61. N-Nitrodiphenylamine
62. N-Nitrosidi-n-Propylamine
63. N-Nitroso-n-ethylurea
64. N-Nitrosoe-n-methylurea
65. N-Nitrosomethylvinylamine
66. N-Nitrosomorpholine
67. N-Nitrosopiperidine
68. N-Nitrososarcosine
69. N-Nitrosopyrrolidine
70. N-Nitrososarcosine
71. Oxymetholone
72. Phenacetin
73. Phenazopyridine and Phenazopyridine hydrochloride.
74. Phenytoin and sodium salt of phenytoin.
75. Polybromulated biphenyl (PBBS)
76. Polychlorinated biphenyls (PCBs)
77. Procarbazine and procarbazine hydrochloride.
78. B-propidactone
79. Reserpine
80. Saccharin
81. Safrole
82. Selenium sulfide
83. Streptozotocin
84. Sulfallate
85. 2, 3,7, 8-Tetrachlorodibenzo-p-dioxin(TCDD)
86. Thioacetamide
87. Thiourea
88. 0-Toluidine and 0-toluidine hydrochloride
89. Toxaphene
90. 2-4-6-Trichlorophenol
91. Tris (1-aziridinyl) phosphine sulfide.
92. Tris (2,3-dibromopropyl) phosphate
93. Urethane

(From 3rd Annual Report on Carcinogens. Summary, Sept. 1983. U. S. Public Health)

Work and cancer

When we consider the relation between work and cancer, the incidence is more on the employees. Now we know that certain chemicals are positively carcinogenic while some others are suspected to be carcinogenic (Tab. 7). In most of the western countries manufacture and use of these chemicals are controlled by legislation. These legisla-tions will even cover import and export of such chemicals. Though we are aware of thecarcinogenic nature of industrial chemicals, we do not know how these chemicals work in the human body to produce cancer or how much time they need to start cancer? Whether these chemicals enter the body through our breath, through the food, through the water we drink ? or through our skin? etc. has yet to be answered. More over, where the employee spends his leisure, what he eats, whether he smokes etc. have to be considered since all these have been found to contribute to ill health and to promote cancer. Estimates of WHO shows that 3 to 6% of all the cancers reported to be related to occupation (TableS).

Since we know now, that most of the carcinogenic agents take a long time to act or induce cancer, it is always better to ask some questions before starting an industry (TableS). Will the handling of raw materials and produc-tion methods be safe for employees? What is the nature of toxicity of materials involved in the production? What is the toxicity of end products? Will there be any health hazard n the storage, handling, transport, distribution and use of the end products? What will be the shelf life of the pro-duct? Will it deteriorate while on storage and produce harmful by products? How will the wastes coming out from the factory be disposed off? Will it pollute air, watir or land? It is best to collect maximum information, to cover the details shown in Table - 9 while planning for a new industry. Further, it is worth while to provide the emplo-yees proper training and necessary safety equipment to do a perfect job with out the risk of health hazards.

TABLE - 8

WORK RELATED CANCERS SOME EXAPLES

Sl.No	Cusative agent	Site of cancer	Related work
1.	X-rays	Skin, bone marrow	Treatment, Industry, Research
2.	Radon gas Radium Uranium	Skin, lungs Bone marrow	Mining, Dial painting Mining & Processing
3.	Ultra violet radiation	Skin	Work in the scorching sunlight
4.	Polycyclic hydrocarbons (Coal, coal oil, Tar, burned tar).	Skin, Nostrils, throat. Urinary bladder	Furnaces, foundaries, metal extraction plants, coal tar oil and gas related works, lathe work like cutting, some cloth mill work.
5.	Benzene	Bone marrow. Lymph nodes	Cloth mills, gun powder, painting, manufact uring of Benzene, Ethlene, yclohexane. Work in chemical Laboratories, Research & Medicine. Dye industries. Rubber manufacturing. Manufacturing of leather, printing, synthetic chemicals. Research and Development laboratories.
6.	1-2Naphthalamine, Au-ramine, Majenta, 4-Bi-phenylamine, 4-Nitro-biphenyle	Urinary bladder	

Sl.No	Cusative agent	Site of cancer	Related work
7.	Mustard gas	Nostrils, Nasal sinus lungs	Mustard gs manufacturing and bottling.
8.	Iso propyl alcohol	Nostrils	Manufacture of Isopropyle alcohol through strong acid process.
9.	Vinyl chloride (VC)	Liver & Brain	Manufacture of vinyl chloride, and polyvinyl chloride plastics.
10.	Chloro ethers	Lungs	Synthetic manufacturing, Manufacturing of ion exchange resins, plastics, Research & Development laboratoris.
11.	Chloroprene	Skin, Lungs, Liver	Manufacture of neoprin rubber items.
12.	Arsenic	Skin, Lungs, Liver	Veterinary medicines, insecticides, wood preservation, mining.
13.	Chromium	Nostrils, Lungs	Manufacture of chromum alloys, dyes, cements, papers, rubber, photographic materials.
14.	Cadmium	Nostrils, Lung, Kideny	Electric Battery, coir manufacture, dyes, printing alloys.
15.	Nickel	Nostrils, nasal lining, lungs	Nickel manufacturing, coir manufacturing, alloys, pottery, mirror and battery making.

Sl.No	Cusative agent	Site of cancer	Related work
16.	Asbestos	Lining of the lung, lung, nostril, periton eum, stomach/colon	Mining asbestos mills asbestos article manufacturing, asbestos transportation and repairing.
17.	Wood saw dust Leather dust	Nostrils, lungs, liver, bone	Wood work, lether work
18.	Thorium dioxide	Liver, bone	Metal purification, in candescent lamps, nuclear power reactors.
19.	Benzidine	Liver breast, lung, Urinary bladder	Dye manufcturing, textile dyeing
20.	Hematite	Lungs	Mining
21.	Coal, smoke, mineral oils	Skin, testes, lungs, urinary bladder.	Tar, bitumin works, wood preservation, road tarring, pesticide manufacturing.

TABLE-9

GUIDELINES FOR COLLECTING INFORMATION ON A PROPOSED INDUSTRY AND PRODUCT

1. Physical Properties
2. Chemical properties
3. Biological response:

(a) Will it be irritant to the skin, eyes and respiratory passage, organs etc?

(b) Will it elicit any ill health if inhaled for a short while or consumed in small quantities?

(c) Will it bring about any health hazzard if inhaled for a long period or consumed in small quantities for *a* long time, say ninety days?

(d) Will the compound metabolize into inert materials or into harmful products with inthe body?

(e) How will it affect the health of plants, birds and fishes - if they are exposed to?

(f) What is the potential to cause cancer (carcinogenicity) ?

(g) What is the potential to bring about changes in chromasomes and hence in the normal pattern (mutagenicity)?

(h) What is the potential of the material to pass from the mother to the foetus in the womb and to cause any deformities? (Teratogenicity)

It will be interesting to go into the details of two modern industries which are capable of inducing cancer in the workers. Both are run only under stringent regulatory measures in western countries.

Asbestos

The chances of getting cancer for the workers engaged in mining, preparation and fabrication of asbestos articles, without the recommended protective equipment is 100%. People who are engaged in fixing or repairing asbestos made appliances or articles are also known to get cancers. From the year 1900 it was known that asbestos causes health hazard. But in 1935 it was proved beyond doubt that asbestos can cause cancer of the lung. Eventhough the information exists, asbestos is used currently in more than five thousand items, from Baby incubator to submarines. Canada has already banned the use of asbestos in baby incubators. Asbestos roofings of schools are replaced on a warfooting in western countries. Inmost of the developed countries, mining, transportation and industries with asbestos is regulated by law. Asbestos products should not release asbestos fibers while in use. In 1969 asbestos law regulated only the firms with government contracts. The standard for permissible exposure was 12 fibers of asbestos per cubic centimeter of air. When the occupational safety and health act was revised in 1972 it was reduced to 5 fibers/cc and 2 fiber in 1976. In 1980 the joint committee of National Institute of Occupational safety and Health and Occupational safety & Health Act recommended elimination of all non essential uses of asbestos & advocated to practice programme to reduce human exposure. The law enjoins that every employee should be informed about the hazards and given appropriate safety equipments, overalls, mask etc. Further, each employee should be clinically screened periodically for any health deterioration. These conditions have prompted the developed countries to start asbestos manufacturing in underdeveloped countries in collabora-tion and thus get out of the legal requirements, payments of compensation to the suffering employees, etc. etc.

Vinyl chloride and Polyvinyl chloride

Vinyl chloride (VC) is a monomer which on polymerisation at 40-70°C temperature will produce poly vinyl chloride (PVC) a popular plastic. When vinyl chloride was discovered it was used as an anaesthetic agent during surgery. This use was discontinued when it was found to affect the normal functions of

the heart. Polyvinylchloride plastic which was made out of V. C. was a great success and very soon more than ten thousand different items for daily use appeared in the market. By the year 1970 this number increased to 18,000. Polyvinyl chloride (P. V. C.) became the material of choice for many things like tongue cleaners, rain coats, shower curtain, syringes, blood bags etc. This increase in number shows corresponding increase in the production of vinyl chloride monomer. The synthesis and supply of vinyl chloride monomer to meet such a great demand was considered an industrial wonder of that period. But in 1974 B. F. Good rich company, who was the major producer of V. C. in U. S. A. called together a meeting of representatives of the Company, employees, government and news papers and informed them that 3 of the company employees who were working in the synthesis of V. C. died due to angiosarcoma of the liver. They explai-ned that, V. C. is suspected to be the causative agent. A medical facility to screen the employees working in the factory periodically was also instituted. According to a statistics which became available in 1975 a total of 32 work-ers concerned with the production of V. C. was found to suffer from angiosarcoma of the liver. Angiosarcoma of the liver is not the only harmful effects known but it is the worst known harmful effect and relevant in this chapter. Workers involved in the polymerization of V. C. and those involved in the cleaning of V. C. polymerization vessels are the people most affected by angiosarcoma of the liver. Modern manufacturing facilities are all automated with computer controlls, reducing the chances of human expo-sure to a minimum. An air sample collected at an average of 15 minutes should not contain more than 5 parts per million (5 ppm). Contact with liquid V. C. is not permitted. In western countries for the manufacture, transpotration, polymerization, and cleaning of V. C. manufacturing plant, safety measures are to be instituted by the employer. Infor-ming the employee regarding the risk in the work, routine medical screening, determination of residual amount of V. C. in the end products etc. are governed by legislation in countries like U. S. A, U. K. and Switzerland.

These two examples are sufficient enough to point out that any industry should be under necessary regulatory control to safeguard the environment and worker's health.

Drug and Cancer

Some time ago a drug called Thalidomide prescribed to some pregnant mothers for morning sickness brought them babies with deformed limbs. After this mishap it has become customary to give license to a drug, only if it quali-fies to be safe in a series of animal experiments. Invesigations on medicines that were used traditionally and successfully for many years showed that some of them were potentially carcinogenic. Arsenic compounds, thorotrast, chlornaphazin, coaltar compounds etc. are known human carcinogens that were used in medicines. Iron dextran, Griseofulvin Niridazole etc. are drugs that are capable of producing tumors in animals but having no repor-ted incidence of tumors in human beings. There are also medicines that are not carcinogenic on their own but when metabolized with in the body turn to be capable of causing cancers. Drugs containing Aromatic amines, Acetylenic groups. Aliphatic halides, Ethelenic groups, Heterocyclic groups. Methyl amino groups are some of the examples. Malignant tumors are also reported to arise as a result of immunosuppressive therapy following organ transplantation.

Further, several drugs used in the treatment of mali-gnant tumors have carcinogenic potential. Then the question why such drugs are being used?. Cancer is an end disease and in the hands of an experienced clinician use of these drugs may help the patient to spend his survival period in comfort, dignity and in the best possible well being. This is a matter usually decided between an in-formed patient and a responsible doctor, who initiates a treatment regime that is not only curative but minimizes the risk of a second cancer at a later stage too. There is a clearcut medical ethics against using carcinogenic drugs for the treatment of non malignant diseases. All these informations points to the fact that drug has to be taken or stopped according

to written instructions of qualified doctors. Self medication is quite harmful.

Smoking and Cancer

Lung cancer came to prominance in 1930. Tobacco was suspected as a cause as we suspect the role of diet and nutrition in cancer formation. But studies carried out upto 1950 confirmed that tobacco smoke can cause lung cancer.

Tobacco smoke contains many chemical compounds among which many are known carcinogens. Mouth cancers are reported to be caused by nicotine and its burned out products which are mainly nitrosamine and alkaloid related products. This is more true in the case of people who chew tobacco or dip snuff in the mouth (Americans). 1, 2-dihy-droxybenzene (catechol) is suspected to be one important factor in the incidence of cancer of the lung. Another interesting finding is that a cigarette while burning in the air, in between two smokings, the smoke emanating (side stream) contains greater quantity of nitrosamines which are carcinogenic. Therefore, a burning cigarette can affect the smoker as well as the people who spends time along with the smoker. Now it is known that a pregnant woman who spends time in a cigarette smoke filled atmosphere is likely to harm the foetus, by passing the carcinogens through the placenta, an example of transplacental carcinogenesis. Developed countries, where people are suffering more from cancer have already taken the lesson and people have taken the message. Smoking has declined considerably in U. S. and it is still going down by 1.1% per annum from 1985. But the reverse is happening in developing countries, where smoking is advertised and popularised so much, a 2% increase is shown in the annual consumption. By refraining from smoking an ordinary smoker can save (1) sub-stantial sum of money enough to feed him and his wife during retirement period. (2) greater period of life span (3) and *a* healthy and trouble free lung during old age.

We come to the conclusion that there are a large number of synthetic chemicals and a number of naturally occurring materials that can promote cancer. We have also to believe that most of the cancers may have a pretty long latent period i.e. from the time of first exposure to the time of occurrence of cancer usually more than 15 years. Ofcourse, certain type of cancers are caused by chemicals or materials, often through occupational exposure. What we do not know is the mechanism by which cancer is initiated or how the carcinogenic chemicals are able to trigger the normal cells into a frenzy of uncontrollable action.

The question is whether we can attribute the cancer to the chemicals that have invaded the environment?. Can we forget about grouping cancers like environment and cancer, food and cancer, drug and cancer etc. and just say chemicals and cancer? Can we postulate cancer to be a natural response of living tissue to a barrage of chemicals?

Oncogenes

While many were looking at work, food, air, water and environment for the cause of cancer some scientists were trying to find out whether specific genes with in the body contribute to the events of human carcinogenesis. Experi-mental studies over the past have identified some cellular genes as potential oncogenes. Involvement of these cellu. lar oncogenes in the carcinogenic process is not proven so far. Their role in inactivation of certain genetic loci, indi-cates their capacity to contribute to tumor induction or tumor promotion. Oncogenes can be described as a category of genes that can be involved in tumor development when their function becomes abnormal. At present, evidence for involvement of oncogenes in human carcinogenesis is only circumstantial. Cytogenetic studies have shown aberration in chromasomes which may affect these cellular genes resulting in the disruption of normal expression leading to neoplastic changes. Research work on the genetic target for tumorogenesis has identified a number of cancer genes or cellular oncogenes which are implicated in carcinogenesis.

Only when the specific role of each cellular genes become known and techniques for their identification will become available then only their potential role could be definitely understood. Oncogenes which can cause cancer are inactive in normal cells. What causes them to initiate activity? It is possible, that cosmic rays, chemicals, etc. may be able to activate a dormant oncogene? Studies that are underway may bring out the answers. Study of cellular oncogenes go parallel to the study of viral oncogenes, that are suspected to play a role in the induction of certain cancers.

Viruses and cancer

In 1910 Peyton Rous showed that preparation made out from cellular (cellular fraction filtered out) chicken sarcoma could induce new sarcomas. Later it was proved that the cause of the chicken sarcoma was a virus, named Rous sarcoma virus. It was also known that the genome was made up of two parts. One containing the genes respon-sible for replication and the second part containing a gene responsible for the induction of sarcoma. From 1910 many investigations were underway trying to find out the inter-relationship between human cancers and viral infections. Three groups of viruses were found to have the potential to produce neoplasia. In most oncogenic virus of both Deoxyrebonucleic acid (DNA) and Ribonucleic acid (RNA) classes (some viruses contain DNA while others RNA) evi-dence is accruing to show that transforming genes are not essential. In general specific transforming genes have been associated with viruses of greater oncogenic potency. Viruses are known to be associated with certain types of tumors i.e. Epstein Bar Virus in Burkitt's lymphoma. Herpes simplex virus-2 in cervical carcinoma and certain Retrovirus in leukemia. It is believed that viruses do play a major role in the induction of these cancers. But only the emergence of techniques to determine whether the genome of EBV is integrated into the DNA of Burkitt's lymphoma or tests to detect viral gene fragments in populations of host cells etc. will help us to rule out the role of viruses in human cancers.

CAN ONE PREVENT CANCER?

Is it possible to prevent the incidence of Cancer? The answer is 'No', because we do not know how exactly and why cancer occurs. Experimental work to find out the answers for the above question is underway in many parts of the world. So far there has not been a real breakthrough in this field. But the information available indicates that certain materials, circumstances and life styles may act as promoters of certain types of cancers discussed in earlier chapters.

The reports did not isolate any causative agent but do strongly suggest that complying to certain "dos and don'ts" may be effective in reducing the risk of cancer. In the absence of strong evidence it is only reasonable to do some thing with reference to them rather than waiting long enough to get the root causes behind each type of cancer. History shows that serious infectious diseases commonly known as killer diseases were prevented without fully understanding their exact causes.This, strongly recommends a similar approach of preventive measures for cancer too. Table 1. lists some of the suggested preventive measures to meet the risk of common types of cancers.

In this chapter it is proposed to bring together few suggestions that have recently come up-inscienticic publica-tions in this field.

Leading experts in cancer researeh opine that majority of malignant tumors could be reduced to a great extent by bringing down the level of environmental pollution. The atmosphere now contains more than sixty thousand chemicals mostly the result of industrialization and civilization (Table. II). Since we are not in a position to lead our lives with out chemicals we have to learn to live with them. We have to learn to use them safely and judiciously.

TABLE I

PREVENTIVE MEASURES SUGGESTED AGAINST SOME OF THE CANCERS

To avoid so as to reduce the risk	Possible Measures To	Site of Cancer
Cigarette smoking / inhalation of tobacco smoke from envi-ronment	Cigarette smoking / inhalation of tobacco smoke from envi-ronment	Lung, Mouth, Larynx, Esopha-gus, Urinary bladder. Kidney, Pancreas. «
Dipping/chewing of tobacco with betal nuts and lime	Dipping/chewing of tobacco with betal nuts and lime	Mouth, Pharynx
Alcohol consumption	Alcohol consumption	Mouth, Pharynx, Larynx, Esophagus
Infection with Hepatitis B virus, Aflotoxin contamination	Infection with Hepatitis B virus, Aflotoxin contamination	Liver
High fat diet, pork, cheese, sweets, desserts, whole milk creams, obesity, pappilfoma viral infections.	High fat diet, pork, cheese, sweets, desserts, whole milk creams, obesity, pappilfoma viral infections.	Colon, Rectum, Ovary, Uterus, Cervics.

POSSIBLE MEASURES		
To avoid so as to reduce the risk	Possible Measures To	Site of Cancer
Nitrates + Aflotoxins from salted pickles, smoked and dried meat and fish.	Leafy vegetables, tonned milkfruits and refrigeration for preservation	Stomach
High fat diet, tight synthetic brassiers	Low fat diet, appropriately fitting cotton brassiers	Breast
Shistozoma infections		Urinary Bladder

TABLE II

USE OF CHEMICALS IN MAN'S LIFE

Particulars	Approximate Numbers
Articles in day to day use/Cosmetics and for pleasure	50,000
Insecticides / weedicides / mixtures	
Fungicides	1,500
Drugs and Tonics	4,000
Excipients	2,000
Food, additives. Flavours	2,500
Total	60,000

Let us for instance take the case of pesticides. Many of them are injurious to health and have proved to be carcinogenic to animals. Common man do not know that a pesticide while killing the pests can also harm the person who use or gets exposed to it.

Then what should we do about them as users? We have to be alert whenever we buy pesticides as to (1) the chemical content (2) whether it is poisonous or bring about any health hazard (3) the precautions to be taken while using it (4) how unused pesticide or the empty pes-ticide container should be diposed of. Make sure that the above informations are given to you at the sales/buying points or shops.

Let us take another example, cooking. Whether it is fire wood choolas or natural gas, cooking fires are known to emit carcinogenic compounds into the kitchen atmosphere. In olden days cooking was mostly done in kitchens situated at considerable distance from the living quarters and generally in open places. The present day kitchen on the other hand turn to be a very congested room usually attached to the living quarters. The proper course in this situation is to keep

our kitchens well ventilated. Care also should be taken as to what things go into the kitchen fire. Plastic milk bags or other plastic coverings are known to emit toxic fumes while burning in the fire. On a long term basis this may pose serious health hazards to the inmates of the house.

In the light of the above examples it should be laid down as a point of consumer protection that manufacturers of house hold items should give the consumer complete instruction regarding contents, how to use it and how to safely dispose the balance part and the container/packaging material, and whether they may pose any hazard to the health.

We have seen that there is no positive proof to show that food (diet) plays a role in the induction or promotion of cancer. Bruce Armstrong, Richard Doll, Jerkins and Jaakko Tuomite are among the important authorities who believe that certain diet and total calorie intake as possible factors that may act as cancer preventing agents. Dr. Kennedy, a nutritionist, found out that Bwman-Birk Inhibitor (BBI-a proteas) a factor derived from soya beans can prevent normal! cells from becoming cancerous in cell culture experiments conducted in her laboratories. In these circumstances it will be interesting to note that the U. S. Government has come out with a list of things 'you may eat less often and another list of things that you may eat more often' so that the risk of contracting cancer may be reduced. To practice this advice, one need not completely stop taking any food that he may prefer but need only make some adjustments here and there and now and then. By doing so the risk of contracting cancer is minimized. Eat a variety of foods, maintain an ideal weight, avoid too much salt and sugar, consume less alcohol. These can be the sum total of the dietary directions which may not only reduce the risk of cancer but also other killer diseases.

Occupational cancers could now be checked with relative ease for we know exactly the type and nature of jobs that may precipitate cancer in the workers and how long it will take to manifest. We have data on materials or chemicals that can

induce cancers. Strict regulations for industrial hygiene, worker safety and consumer protection can bring down these health hazards. A safety report in tune with details given in Table 9 of chapter causes of cancer" should be made mandatory for giving license to any new industry.

DRUGS

In the case of drugs there are clear cases calling for caution. Female children born to women who were treated with high doses of the synthetic oestrogen, diethyl stilbesterol developed adenocarcinomas of the vagina even at the age of 12-19 years. The treatment was to prevent abortions or premature delivery. These cancers which were on the increase in U.S. established the possibility of drugs passing from the mother to the foetus through the placenta. But in cases of children born to women treated with the same hormone in Germany did not contract cancer, may be, because the mothers were given 'Gestagens' along with oestrogens and this might have prevented the cancer inducing effects of the said drug. Further studies are underway to unravel the mechanism that might have taken place in this case. Facts like this strongly suggests that drugs should go to the market only after strict toxicological and safety screening and clearance by conscientious Sate authorities.

What people in general can do regarding drug hazards is to adhere to the physician's advice and avoid self medication. It is desirable that individuals keep a personal file of prescriptions to keep track of all medicines that were given to them. It is also to one's advantage to carefully go through the pamphlets generally provided with the drugs and to follow a practice of buying only drugs manufactured by well reputed drug companies

TOBACCO

The increase in lung cancer was noted with alarm in 1930. At that time smoking and tobacco was suspected but it took another 20 years to gather some proof to say that tobacco

smoking is mostly responsible for lung cancers. A significant aspect of the above conclusion is that it did not come out of any direct scientific experiments. It was simply the result of monitoring smokers through 3 or 4 decades and finally getting the cause of death certified by competent authorities. This study covered various aspects as the nature and place of work, residence, cooking practices, drinking and smoking of the persons involved. As many as 40,000 doctors in U. K. participated in another elaborate study of the relationship between smoking, cancer and other related diseases. This study continued for a period of 20 years and concluded that smoking could be the cause of deaths by bringing cancer. The above studies also indicate strong association of tobacco use not only with lung cancer but also cancers of mouth, throat, larynx, chronic obstructive lung diseases and vascular diseases. These studies do no prove tobacco to be a carcinogen but very strongly suggest association of tobacco along with the listed health hazards. The western countries have all taken note of the seriousness of tobacco and have indicated a quantum fall in the volume of tobacco trade.

Public Health Authorities can do much in this matter. Information on tobacco use and health hazards could be advertised. Children may be instructed and warned against tobacco habbits. Adult users may be encouraged to stop or atleast reduce the daily consumption. Users of tobacco may be guided how they should rinse their mouth after chewing tobacco, especially not to go to bed with tobacco inside the mouth. The Government may also have a policy of dis-couraging advertisements to popularise use of tobacco and aim at ultimate banning of all advertisements on tobacco products. It should also think seriously of suitable legisla-tion to impart punishment for selling tobacco to juveniles.

The next step that could be taken to prevent cancer deaths would be arrangements for early detection. It will help a great deal to treat the disease successfully. A regular and almost compulsory medical check up every alternate, year, especially

to those who past 30 years of age by qualified doctors with adequate equipments would be the positive and reliable set up for early cancer detection. But in a country like ours where one out of every eight person is likely to be affected with cancer and where facilities for detecting cancers are rare, regular check ups are difficult. Therefore let us see what tips an ordinary man should bear in mind to detect cancer or the indicators or symptoms of possible cancer problems. These indicators could be listed as constant and severe headaches with nausea and vomit, ting not amenable to routine treatment (2) growths in the nostril and ear (3) swollen and dry throat with or without cough not responding to treatment (4) persistant cough accompanied by a change in the voice (5) gastric distur-bances along with swallowing problems (6) persistant bowel problems with loose motion, traces of blood in the stool etc. (7) a feeling of fullness even after passing stool (8) problems for voiding urine (9) abnormal bleeding or discharge from vagina, an irritant or itching cervics not responding to routine treatment (10) lumps in the breast (11) swelling in any part of the body not responding to treatment (12) dental sores caused by irregularly placed natural teeth or by ill fitting artificial dentures (13) sores appearing on the cheeks, corner of the mouth, lips or tongue. (14) moles or dark brown spots any where on the body which itches often or slowly grow in size.

Looking for the above symptoms or signs may help us to detect cancer at an early stage. But even the above enu-merated signs show up only when cancer become establi-shed and urgent treatment thereafter becomes a must. Therefore the need for well equiped detection centres and adequately trained persons have become imperative. It is urgent that public attention should turn on to these things without any more loss of time.

Personnel

Doctors, Nurses, Pharmacists, Technicians, Cleaners, Security people and any other categories of workers invo-lved in the handling of the cytotoxic drugs should be adequately

trained in various aspects of inuse safety. These people should be made aware of the known risks, relevant techniques and procedures for their handling, necessary competence in the use of protective clothings, respirators, gloves, goggles etc., spill and waste management, first aid procedures for acute and accidental exposure.

All permanent and temporary employees should be clearey informed of the above facts. It will be prudent that staff members who are pregnant or breast feeding are not permitted to prepare or administer cytotoxic drugs. Above all,the staff should be aware of the benefits of good laboratory practices and asceptic technology.

Spills and Waste Management

Irrespective of the precautions taken-breakages of vials and spilling of chemicals are liable to happen in any insti-tution. During these breakages and spills a worker may get contaminated in many ways. Cytotoxic drugs may get into the eyes or contaminate th skin, a needle or broken syringe may get lodged in the body, aerosoles containing the drug may be inhaled. Affected eyes and skin may be washed profusely with water. Cuts made by broken vials may be washed with plenty of water. Exposed persons should seek medical attention immediately or as early as possible.

Spills and breakage of vials containing cytotoxic drugs should be cleaned up immediately by trained persons wear-ing protective equipment. If spills are not cleared immedi-ately it should be properly protected or isolated and a *caution* sign placed near the site of spill.

Cytotoxic and related waste material should be handled with care. Cytotoxic waste should have separate waste bins which can be kept closed and will not contaminate the environment. Cleaners handling these should wear gloves, gowns and appropriate shoes. No amount of cytotoxic waste should be flushed directly through the laboratory sink into the

Municipal sewer, if there is a law objecting to it. They should be discarded into the sewer only after inactivating with appropriate chemicals.

Safety equipments like dust and mist respirators, face masks, goggles, gowns with full sleeves,shoes, appropriate waste bins or bags, chemical inactivators and absorbers specially meant to clear cytotoxic drug spills should be available.

Records

Records of incoming purchased drugs, prepared and administered doses, methods of disposal of waste etc. should be maintained and made available for scrutiny by health officials.

Legal

All temporary and permanent employees must be in-formed that they may be required to work with cytotoxic agents as part of their duty. Toxic nature of the work may be explained to them in balanced and simple terms. Need for adhering to procedures in handling cytotoxic drugs and accessory equipments should be made clear to them. It should also be explained that these procedures are believed to provide adequate safety and 100% protection can not be guaranteed. An exposure registry may be maintained to record such incidences. Hospital (or Research Centre) may institute procedures for disposing the waste in consultation with local governmental bodies. Institute may also have a code of practice to handle cytotoxic drugs-drawn up in consultation with guidlines that are available elsewhere. A legal counsel may be kept in the Institute's pay roll for consultation in such matters as and when required.

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Erratum

1. Page 4. Second para. First sentence to be read as: The remaining malignan tumors are generally known as miscellaneous tumors.

2. Page 9, line22
   leisions — lesions

3. Page 10, line 13
   undecended — undescended
   line 14
   eymptom — symptom

4. Page 12, line 22
   teeatment — treatment

5. Page 25, 1st line
   constantey — constantly

6. Page 28, Second para, line 12 vegetables — vegetables

7. Page 30
   Riborflavin — Riboflavin

8. Page 40, line 24 & - and

9. Page 44, last line
   chromasomes — chromosomes

10. Page 47
    cervies — cervix

11. Page 52,
    line 17 no — not

PERSONNEL SAFETY

A note of caution on procurement, storage, dispensing and administration of cytotoxic drugs.

The common types of treatment available for cancer are surgery, radiotherapy, hormone therapy, immunotherapy and chemotherapy. Among these, chemotherapy is a recent form of treatment that has produced success in certain cases of cancers like leukaemia, cancer of neck and head, hodgkins disease etc. In the case of other tumors, when they have spread or metastasised to other organs, chemotherapy is resorted to.

Drugs and chemicals used in chemotherapy are known as cytotoxic drugs because they act like poison and kill the cells in the body. Thus, while treating their patients (Physicians, nurses, pharmacists, technicians, helpers, cleaners etc.) the healthcare personnel may inadvertently be exposed to cytotoxic drugs through inhalation, skin absorption or trauma. Evidences are available to show that exposure to cytotoxic drugs can bring about serious health hazards.

Any Institution where antineoplastic or cytotoxic drugs are being used, have the moral responsibility to institute safety measures. These safety measures, though not mandatory in nature will help to avoid unwanted exposure with cytotoxic drugs to hospital personnel and the enviׁonment.

American society of Hospital Pharmacy and Office of Occupational Safety and Health Administration of U. S. A have come out with some suggestions or precautions that are to be taken while handling cytotoxic drugs. Health care personnel who are involved in the handling of chemotheraputic drugs are advised to follow the above guidelines to ensure safety. The above guidlines could be summarised as follows:

STORE

Area meant for receiving and storing cytotoxic drug consignments should be well planned. It could be construc-ted as an isolated area with a large warning sign. If this could be constru'cted to have a vertical air flow as in a biological safety cabinet with an exhaust line fitted with necessary filters to adsorb the vented chemicals, it will be excellent. Cartons of cytotoxic drugs arriving from the manufacturer or supplier should be examined carefully for damage. Cartons should be opened only by authorised persons wearing gloves, closed gowns, shoes, mist and dust type respirator and eye gaurd. Each vial should be scrutini-zed for damage and arranged in the indexed places along with instructions supplied by the manufacturer. Store racks should be designed to prevent containers or vials from falling down. No other drug should be stored along with cytotoxic drugs at any cost. An adjancent area or cubicle should be available to put the cartons arriving damaged. Damaged containers should be examined only with necessary protective equipment.

Place of preparation

It will be ideal to prepare cytotoxic drugs in a centra) area so as to reduce the cost of establishment. A suitable class of biological safety cabinet, meeting the requirements laid down by National Sanitation Foundation Standard (U.S.A.) and installed with in a clean room may be the choice place for preparation of cytotoxic drugs. If such a place is not available a quiet and clean room should be used till the facility is made available. If a biological safety cabinet is not available a respirator with a high efficiency filter, with goggles, gloves, gown and shoe may be used by the person preparing them.

Each drug should be prepared as per instructions given by the manufacturer. Instruction leaflets of each new consignment should be carefully checked for addition or deletion in the routine procedures, to ensure patient safety.

The guidelines should be available in the preparation room for ready reference.

The person preparing the cytotoxic drug using a biolo-gical sefety cabinet should wear a goggles, dust, & mist type respiratpr, back open gown with long sleeves, latex gloves etc.

Chemicals to inactivate drugs, materials for clearing accidental spills, required waste bins, labels, an emergency eye wash area etc, should be available with in the drug preparation facility. Entry should be restricted to authorised persons only.A work load register should be maintained and all prepared drugs numbered and entered in the register so as to keep track of the possible exposure rate.

In the preparation room facility should be available for labelling the syringes, vials 8-1. V. bottles with the patients name, room number, the name of the drug, quantity to be administered, route of administration. Date and time of preparation and expiry time if any should be appropriately marked.

Placo of administration

II is slways nice to have a separate room for admini-stration of cytotoxic drugs. Surgical gloves and gowns may be used by the person administering the drug. It will be wise not to wear respirators, goggles and masks while administering the drug so as to put the patient at ease. Debilitated patients may be given the drug in their own bed.

Administration of cytotoxic drugs should be carried out only under writteT orders from qualified physician and special instructions if any should be adhered to. Materials and drugs to treat accidental extravasations and an emer-gency eye wash area should be available. Name of the patient, name of the drug, dose, time of previous injections should be double checked before each administration. Records of each administration should be scrupulously maintained with name and signature of the staff on duty.