Teacher Background

Cancer

Note: The Teacher Background Section is meant to provide information for the teacher about the topic and is tied very closely to the PowerPoint slide show. For greater understanding, the teacher may want to play the slide show as he/she reads the background section. For the students, the slide show can be used in its entirety or can be edited as necessary for a given class.

<u>What is Cancer?</u>

The term cancer was coined by the Greek physician, Hippocrates (460 – 370 BC) from the Greek word karkinos (carcinos) meaning crab which he used to describe the fingerlike projections of tumors. The Roman physician Celsus (50 – 28 BC) translated karkinos, the Greek word for crab, into cancer, the Latin word for crab. Roman physician Galen (130 – 200 AD) used the word oncos (Greek for swelling) to describe tumors. Tumors have been seen in Egyptian mummies with growths suggestive of bone tumors and described in hieroglyphics as far back as 3000 BC when 8 cases of breast tumors or ulcers were reported along with cauterization, using a tool called the fire drill, as the means of destroying the tumor.(1)

<u>How Do Normal Cells Differ From Cancer Cells?</u>

In normal cells, the rate of new cell growth and old cell death are kept in balance. During mitosis, the cells divide in a controlled fashion. When cells, like skin, age and slough or become damaged, basal cells will replace the cells. To replace the old or damaged cell, the basal cell divides forming two cells – one cell remains as a basal cell and the other becomes part of the tissue (skin in this case) and loses the ability to divide. (2) As a cell meets a boundary, such as another cell or tissue (group of similar cells), the cell is genetically programmed to go into the G_0 stage and stop dividing. In addition to sloughing as cells age, they may be genetically programmed to undergo apoptosis (programmed cell death) which balances the cell count as new cells grow.

Sometimes, however, the DNA of the cell can be mutated (changed) by factors such as environmental exposure to chemicals, viruses, and radiation, and sometimes by an inherited faulty gene so that the cell begins to mitotically divide abnormally. The abnormally dividing cells do not observe signals to cease dividing or to undergo apoptosis that other cells recognize. These cells are capable of invading other tissues both locally and in other parts of the body causing pain or discomfort. A mass of abnormally dividing cells that can invade other tissues is known as cancer. (2)

What Types of Gene Mutations Could Cause Cancer?

Genes (segments of the DNA coding for a specific protein) involved in abnormal cell division include mutations in the DNA of proto-oncogenes, tumor suppressor genes, and DNA repair genes.

a. Proto-oncogenes are normal genes that code for proteins that guide normal cell growth and cell division. Oncogenes arise from mutations of proto-oncogenes and can cause cancerous cells to begin to grow by producing excessive amounts of growth-control proteins which make the growth-signaling pathway hyperactive thus stimulating excessive cell growth and division. For example, the bone marrow cancer, chronic myelogenous leukemia (CML) is caused by the Philadelphia chromosome (Ph) which is a spontaneous translocation in a bone marrow cell. ABL is a normal proto-oncogene on chromosome 9 and codes for the enzyme tyrosine kinase which is made in controlled amounts; the normal gene BCR is on chromosome 22. In the translocation occurrence, the Philadelphia chromosome is formed by the ABL gene from chromosome 9 spontaneously translocating into the site of the BCR gene on chromosome 22. The two gene segments -- BCR-ABL -- fuse becoming an oncogene which encodes for an oncoprotein that is larger than the normal tyrosine kinase and which causes uncontrolled and unregulated tyrosine kinase activity and malignancy. (3, 4, 5)

The initial onset of CML is a slow-growing phase followed three to five years later by an aggressive and lethal phase, until recently when Gleevec was developed. Gleevec is the drug imatinib mesylate. It was developed by Dr. Brian Druker at Oregon Health and Science University (OHSU) and was approved by the FDA (Food and Drug Administration) for human use in 2001. Gleevec is the world's first targeted cancer therapy which inactivates the BCR-ABL oncoprotein in the cancer cells thus eliminating uncontrolled and unregulated tyrosine kinase activity. Gleevec has not been found to be harmful to normal cells. Since 2001, many CML cancer patients with this formerly uniformly lethal disease are cancer survivors. (3, 4, 5)

b. Tumor suppressor genes are normal genes which code for proteins that work, in response to DNA damage, to orchestrate the repair of the damaged DNA and, if the DNA cannot be repaired, to signal the cell to undergo apoptosis. Ultimately, the tumor suppressor proteins suppress tumors by inhibiting growth and replication of mutated cells. When the tumor suppressor gene itself is mutated and doesn't function, then cancer can result because the growth and replication of other mutated cells isn't kept in check. In ovarian cancer, for instance, a mutation can be found in the p53 tumor suppressor protein. Normally, this protein triggers apoptosis in cells that have DNA damage but the p53 mutation prevents the destruction of those damaged cells. (2)

c. DNA repair genes are genes which code for proteins that snip out and replace mutations in the DNA of cells. If there is a mutation in the DNA repair gene itself, the repair doesn't occur and

mutations accumulate. The DNA repair genes are especially important in repairing ultraviolet sun damage to skin DNA which causes the DNA to form thymine dimers when base pairs ATAT occur next to each other on the same chromosome. People who have inherited the autosomal recessive trait xeroderma pigmentosum have a defect in the genes coding for proteins making up the nucleotide excision repair (NER) complex which repairs pyrimidine (thymine and cytosine) dimers. Thus these individuals develop fatal skin cancers at 2000x the norm and internal cancers at 10 -20 x the norm. (6)

Cancer may start because of an accumulation of mutations in oncogenes, tumor suppressor genes, and DNA repair genes. If, for instance, the tumor suppressor gene is mutated, it allows mutated cells to proliferate. There could also be further mutations in the DNA repair genes and proto-oncogenes could mutate into oncogenes creating a highly metastatic tumor. Mutations can also be seen in genes that activate and deactivate carcinogens and which control the cell cycle, cell aging (senescence), apoptosis, cell signaling, and cell differentiation. As more and more cancer cells grow into a tumor, they lose the ability to stop growth when in contact with neighboring cells. They also produce cytokine signals and protease proteins which destroy the basal membrane layer and surrounding tissue to reach blood vessels and/or lymphatic ducts. (2)

What Is The Difference Between a Benign Tumor and a Metastatic Tumor?

Sometimes, normal cells will increase in number as in the normal healing response or in response to increased and repetitive use, such as in the development of a callus while learning to play the guitar. This type of growth is known as a hyperplasia in which normal cells make more copies than usual. Cells of a hyperplasia are orderly, well differentiated, and recognizable as normal cells. If cells begin to overgrow and shift their position, the tissue is described as a dysplasia, which may or may not be of concern. The cells in a dysplasia don't have the arrangement and function of normal cells.

Neoplasm means new growth and describes the growth of cells beyond their normal boundaries. They are classified in two categories – benign and malignant growths (or tumors). A benign tumor is not classified as cancerous, since the cells do not migrate to other parts of the body, the cells are well differentiated, and growth is slow and usually bound in a limited area. Cysts and polyps are examples of benign tumors. Benign tumors are usually surgically removed and don't tend to grow back. When cancer is diagnosed, it is a malignant tumor that has been detected. This type of tumor is an overgrowth of cells that do not resemble normal cells. They may look immature and divide rapidly and in a disorderly fashion, and they have the capability to invade underlying tissues and to metastasize. (2,7) Metastasis is the ability of cancer cells to penetrate into lymphatic ducts and blood vessels, circulate in the bloodstream, and invade tissues elsewhere in the body. (2) Invasion of other tissues by the cancer cells can begin to interfere with the normal functioning of the invaded tissues becoming potentially life threatening.

<u>What Types of Cancer Are There and How Are They Named?</u>

Cancer is the name given to a broad spectrum of cells that are abnormally dividing with the capability of invasion and metastasis. Cancer is not just one disease: Over 100 different types of cancer have been documented. The type of cancer is determined by the organ and/or cell type where the cancer begins, such as thyroid cancer, prostate cancer, colon and rectal cancer, pancreatic cancer, ovarian cancer, uterine or endometrial cancer, breast cancer, kidney cancer, bladder cancer, oral cavity and throat cancer, and lung cancer. When a cancer begins to metastasize, the name of the cancer remains the original name even when found in other tissues. For instance, if a person was diagnosed with breast cancer as the primary source of the cancer and secondary tumors were seen also in the lung, the tumors in the lung are known as metastatic breast cancer, not lung cancer.

 Cancer cell types can be further grouped into larger categories:

a) carcinoma – cancer that begins in the skin or in tissues that line or cover internal organs, such as all of the cancers mentioned in the previous paragraph (ovarian carcinoma or prostate carcinoma, as well as skin cancers such as basal cell carcinoma and squamous cell carcinoma (the skin cancer melanoma is an exception since it forms in melanocytes rather than in epithelial tissue)) (2, 4)

 b) sarcoma – cancer that begins in bone, cartilage, fat, muscle, blood vessels, or other connective or supportive tissue, such as osteosarcoma originating in the bone and gastrointestinal stromal (supportive connective tissue framework of the organ) tumor (GIST), which was previously incurable but was found to respond dramatically to the drug Gleevac (2,4)

c) lymphoma and myeloma – cancers that begin in the cells of the lymph nodes and the immune system, such as Hodgkin and non-Hodgkin's lymphomas which develop in the lymphatic system, and chronic myelogenous leukemia (CML). CML was the first disease to be labeled as leukemia by Rudolf Virchow in 1845 and is a cancer which does not form a tumor. CML begins in the blood-forming bone marrow tissue, causing large numbers of abnormal white blood cells to be produced and enter the blood. As mentioned earlier, it is now successfully treated with Gleevec. (2,4,5)

 d) central nervous system cancers – cancers that begin in the tissues of the brain and spinal cord, such as glioblastoma multiforme which is the most frequently occurring brain cancer in adults. (2, 4) Additionally, prefixes are often added to refer to the location where the cancer began, such as adeno- meaning gland. So breast, uterine, and ovarian cancers can be classified as adenocarcinomas, which would be added to the name of the organ, i.e. uterine adenocarcinoma. (2)

<u>How Are the Stage and Grade of Cancerous Tumors Determined?</u>

Each type of cancer is further classified as to the stage and grade of the cancer. The stage refers to how much the cancer has spread from the original source and ranges from I (very localized without invasion

of underlying tissue or lymph nodes) to IV (metastasis is widespread). Sometimes, the stages are subdivided, for example into stage IA (tumor limited to lining only), stage IB (tumor invading the underlying muscle by less than 50%), and stage 1C (tumor invading the underlying muscle greater than 50%). Grade refers to how aggressive or fast growing the cancer cells are and ranges from I (slow growing and slow to spread) to IV (fast growing, easily metastasized, and less responsive to therapy). (2) Stage and grade of the cancer are determined by a combination of the type of cancer and the pathology reports obtained from biopsies, CT and other scans, and surgery and both help determine the patient's therapy and chance of survival.

How Are the Stage and Grade of the Cancer Used to Determine Treatment and Chance of Survival?

Stage and grade of the cancer help determine the patient's therapy and prognosis (chance of survival). For example, a patient with stage IA grade I uterine adenocarcinoma would have surgery in which all of the reproductive organs and associated lymph nodes would be removed and a visual search for evidence of tumors in the abdominal cavity would be conducted. This type of cancer may require no further treatment, especially if the pathology report shows no evidence of cancer cells in the lymph nodes and the surgeon sees no visual evidence of tumor in the abdominal cavity. A person with stage IA grade III uterine adenocarcinoma would have the same surgical procedure as the stage IA grade I patient but additionally the omentum (an apron-like mass of connective covering the large and small intestines) would be removed and tested for cancer cells in the fat tissue. Chemotherapy and brachytherapy (localized radiation) treatments would follow shortly after the surgery. If the tumor post surgically had been found by the pathologist to have invaded the underlying muscle of the uterine lining, the classification would be changed to stage IB grade III or stage IC grade III, depending on the depth of invasion of the cancer cells into the muscle. If the pathologist also found the cancer had invaded the cervix, the classification would have been changed to stage II grade III. For these three stages, chemotherapy and brachytherapy treatments would follow shortly after surgery. (8)

If tumors had been found in the abdominal cavity during surgery, debulking (removal of tumors) around the bowel and bladder and washing of the cavity would be done during the surgery and the classification changed to stage III grade III. Chemotherapy and full pelvic radiation would follow as soon after surgery as the patient could tolerate. If a person had a pre-surgery CT scan which showed the primary tumor had invaded the bowel or bladder or had metastasized to the lungs, liver, or brain, the classification would be stage IV grade III uterine adenocarcinoma. The patient would first be treated with chemotherapy to reduce the size of the tumors before having surgery to remove the primary and secondary sources of the cancer. Following surgery, the cancer would be treated with further chemotherapy and extensive radiation treatment. While the stage and grade determinations vary depending on the type of cancer, in general, the lower the stage and grade classification, the higher the chance of survival. (8)

<u>What Are The Symptoms of Cancer?</u>

There are some clear symptoms that could indicate cancer and that should be checked by a physician as soon as possible. They include detection of a lump, especially in the breast tissue of men and women and testicular tissue of men, unusual bleeding or discharge, a sore that doesn't heal or a change in the shape and/or color of a mole on the skin, unexplained coughing, and unexplained stomach, back, or abdominal pain. However, some cancers, especially in the early stages, do not exhibit any symptoms.

<u>Why Are Cancer Self-Diagnosis and/or Cancer Screening Important?</u>

Because some cancers do not exhibit any symptoms, especially in the early stages and because of their metastatic nature, there is much information on cancer self-diagnosis, cancer screening, and cancer prevention in the media. It is important to have the prescribed routine screenings for cancer. The goal is to spot the indications of a malignant tumor early so it can be removed and treated before it can invade surrounding tissues and metastasize to other areas of the body. Another goal is to provide information on ways to lower the risk of developing cancer through diet, exercise, stress reduction, and anti-smoking campaigns. 80 – 90% of all cancers occur in people with no family history of the disease and are thought to be caused by lifestyle choices, by environmental exposure, and by unmitigated stress. 10% of cancers are known to be genetically linked within families, such as the inherited genes BRCA-1 and BRCA-2 genes which cause breast and ovarian cancer. In 2010, there were 1,529,560 new cases of cancer, not including non-melanoma skin cancer, and 569,490 deaths. Scientists have determined some direct correlations between lifestyle choice and cancer, such as with smoking and lung cancer, but they do not know all of the reasons why cancerous tumors develop. (2)

Screenings for women include a yearly Pap smear of the cervix beginning at puberty which screens for abnormal cell growth and for presence of HPV (<u>H</u>uman <u>P</u>apilloma <u>V</u>irus), both a cause cervical cancer. Another screening for women is a monthly breast self-examination beginning at puberty and annual mammograms beginning at age 50 for detecting breast cancer. For men, monthly self-examination of the testes should begin at puberty to detect testicular cancer, and, as the man ages, there is a screen of PSA (prostate specific antigen) levels in the blood for detecting prostate cancer (although there are still many false positives and negatives with this test) along with a digital rectal exam (DRE) which can detect changes in the size of the prostate.

For men and women, it is important to have a colonoscopy beginning at age 50 to detect colon and rectal cancer and as one ages, an overall skin examination should be done by a dermatologist to detect skin cancer. A screen of CA 125 (cancer antigen 125) levels in the blood to detect ovarian cancer in post-menopausal women is being developed but is still in the trial phase. The risk of developing cancer does increase as a person ages due to longer exposure to risk factors and for this reason, many of the screening tests are recommended for those over 50 years old. Through screening, the use of

mammograms in the U.S. has reduced the mortality rate for breast cancer by 30% since 1989, PAP smears have reduced the mortality rate for cervical cancer by 60% since 1975, and colonoscopies have steadily reduced the mortality rate for colorectal cancer. (2)

Regular prescribed screenings help detect the presence of precancerous cells, such as benign polyps in the colon, or cancerous cells in the early stages of growth. The earlier the detection and diagnosis of cancerous cells, the greater the options are for intervention and the higher the survival rate. Depending on how aggressively the cancer cells are growing, it is thought that many cancerous tumors take anywhere from 5 – 8 years to be large enough to be readily detected in self-examination. For instance, a pea size lump detected in self-examination of the breast is thought to have been growing for up to 8 years.

How Happens If Something Suspicious Is Found?

If a suspicious result occurs from any of these screening tests, a biopsy (or small sample) can be taken of the suspicious tissue and examined by a pathologist or run through a proteomic profile or genomic microarray to determine if cancer-related proteins or genes are present in the tissue. (2) If the biopsy comes back positive for cancer, then the physician would review the options for treatment which could include CT, MRI, PET, and other scans to discern the possible spread of the cancer, surgery to remove the primary tumor and any surrounding metastatic tumors, chemotherapy to kill all fast growing cells including the cancers cells, and radiation treatment which kills cells in the targeted area including the cancer cells. Immunotherapy, such as Herceptin, can block growth factor receptors and slow growth of cancer cells, such as in breast cancer. (2) Since each cancer is different, the treatment would vary depending on the type of cancer, the stage and grade of the cancer, and data from previous studies and clinical trials showing what has worked the best in the past for that particular type of cancer.

How Can Individuals Decrease Their Risk of Cancer?

While no one really knows what triggers cancer to develop and while it may be impossible to prevent cancer in every case, there are suggestions from the National Cancer Institute (NCI) and the American Cancer Society (ACS) that could help lower the risk of developing cancer by decreasing exposure to carcinogens, such as tobacco, environmental toxins, alcohol, to sunlight, to x-rays, and to some viruses and bacteria, and by eating a healthy diet, exercising regularly, and decreasing stress.

a. Tobacco Use –The NCI and ACS advise avoidance of tobacco use in any form, including cigarette, cigar, pipe, and smokeless tobacco. The jury is still out on use of e-cigarettes since there is no long-term data yet. Tobacco use can cause lung cancer and cancer of the mouth, larynx, esophagus, stomach, pancreas, kidney, and bladder. One in three cancer deaths is due to the use of tobacco. Cancer has been diagnosed in patients who were not smokers but lived with a person who smoked (called secondhand smoke inhalation) and in patients who did not smoke and did not inhale second smoke but who were in contact with clothes, hair, etc. of someone who smoked (called tertiary smoke inhalation).

b. Clean Environment - A clean environment includes one free of tobacco smoke, atmospheric pollutants such as smog, and domestic pollutants such as dry cleaning fluids (perchloroethylene, trichloroethylene), aluminum containing deodorants, perfumes (phthalates), household pesticides and herbicides, cleaning products (with alkylphenols), and PVC plastic containers used to heat food or liquid. (12)

c. Alcohol - In addition, imbibing more than one 12 oz. drink of alcohol daily for women and two 12 oz. drinks of alcohol daily for men increases the risk of cancer of the mouth, throat, esophagus, and liver and breast cancer in women. The combination of smoking and drinking increases the risk of cancer significantly, especially for mouth, throat, and esophageal cancers. In people who both smoke and drink, the cancer risk is more than 40 times greater than that for nonsmoker/nondrinkers. (2)

d. Sun Exposure - Sun exposure without the use of sunscreens and protective clothing can cause DNA damage in the skin cells, such as the formation of thymine dimers. While the cells are equipped with mechanisms to repair the radiation damage to DNA, repeated sun burns where the skin is red and tender to the touch and/or forms blisters can interfere with the cell's ability to repair its DNA.

e. Exposure To X-rays – X-rays are helpful when one has a broken bone or during a medical screening, such as a mammogram, but overexposure to x-rays does tends to increase the risk of developing cancer, such as leukemia. While most dentists usually take dental x-rays once a year, routine dental x-rays taken every other year or every third year give the dentist the needed information and limit patient's exposure. Of course, if there is an abscess or other dental concern, x-rays would be necessary even if they had been taken recently. Dentists are beginning to use a lead neck shield to prevent x-ray exposure to the thyroid gland in addition to the lead apron shield draped over the body trunk they have always used to protect the ovaries and testes, in particular.

f. Viruses and Bacteria - In the case of viruses and bacteria, their DNA can be inserted into the DNA of the human cell which can lead in some individuals to abnormal cell growth and cancer. Exposure and contraction of hepatitis B virus through food and fluid intake can lead to liver cancer and a vaccine has been developed to protect against hepatitis B virus. There seems to be a connection between contracting *Helicobacter pylori* bacteria in the stomach and stomach cancer. *H. pylori* has long been known to cause stomach ulcers and is now being implicated in causing stomach cancer as well. It can be treated with antibiotics and both partners in a relationship should be treated as it can be passed back and forth through kissing.

    Practicing safe sex will help prevent the exposure and transmission of human papilloma virus (HPV) which can lead to cervical cancer. There is no treatment for HPV once it has been

contracted from a sexual partner. HPV can be detected in a Pap smear for women. A vaccine has been developed which prevents HPV infection and is being strongly recommended for pre-adolescent girls and boys. More recently, cases of HPV- related throat cancer have been reported in both men and women, due to oral sex.

Another sexually transmitted disease, HIV, does not cause cancer but leaves the patient with a compromised immune system making them susceptible to contracting Kaposi's sarcoma-associated herpes virus which causes the skin cancer, Kaposi's sarcoma. There are many treatments available to treat HIV which can prolong the life of the patient but none of them cure the infection. There is currently no vaccine to prevent HIV infection, although one is being developed at ONPRC. (2) For both HPV and HIV, the best defense is to know a sexual partner's past sexual history and practice safe sex (using condoms) to prevent coming in contact with the virus.

g. Anti-Cancer Diet - In addition to avoiding tobacco products, limiting alcohol consumption and exposure to environmental toxins and sun, and practicing safe sex, ways to further minimize the risk of developing cancer (and other diseases as well, such as heart attack, stroke, hypertension, and adult onset type II diabetes) are by eating an anti-cancer diet, exercising on a regular basis, maintaining a normal body weight, and reducing stress. An anti-cancer diet includes a high fiber diet rich in fruits and vegetables – 4 to 13 servings per day. This includes 2 to 5 servings daily of fruits, with an emphasis on fruits containing blue anthocyanins, such as blueberries and blackberries, red lycopenes, such as watermelon and raspberries, and purple resveratrol, such as grapes and plums, and 2 to 8 servings daily of vegetables, with emphasis on legumes, such as beans, peas, lentils, and peanuts, and dark-green vegetables, such as broccoli, spinach, and kale; red lycopenes , such as tomatoes and red bell peppers; orange beta-carotenes, such as carrots and yams; and blue anthocyanins, such as eggplant and purple cabbage. An anti-cancer diet also includes a lower intake of fat, which means limiting intake of beef, pork, and lamb, processed meats like bacon, sausage, hot dogs, and cold cuts, fried foods, and trans fats, and increased intake of fish and eggs rich in omega-3 fatty acids, oils such as olive, canola, or flaxseed, and low-fat dairy products. Diets high in fat and low in fruits and vegetables have been thought to contribute to increased risk of colon, lung, postmenopausal breast cancer in women and prostate cancer in men. (2) Green tea is important in an anti-cancer diet because it contains polyphenols called catechins, especially epigallocatechin gallate (EGCG), which are molecules that interfere with the formation of new blood vessels by cancerous cells. While green tea and black tea both contain antioxidants, the polyphenols are destroyed during the fermentation process to form black tea. (9, 10, 11)

 The anti-cancer diet also includes a lower intake of sugars, which means limiting sweets (candy, cake, pastries, cookies, and sugary drinks) and foods made from highly processed grains (cereals, chips, crackers, white bread, white pasta, and white rice). Better suggestions for sweets

are fruits and dark chocolates and for grains are multi-grain cereals, chips, crackers, and bread, whole wheat pasta, and brown rice. In general, sugar feeds cells, including cancer cells, and makes them grow faster. In addition, when foods with a high glycemic index are eaten, such as foods high in sugar, white bleached flour and cereal, white potatoes, and sweetened drinks, it causes the body to release insulin to enable the glucose to enter the cells. At the same time, insulin growth factor (IGF) is released whose role is to stimulate cell growth. Insulin and IGF also increase inflammation which stimulates cell growth. It is known that insulin peaks and IGF release stimulate growth of cancer cells and stimulates their ability to invade surrounding tissue. In addition, studies show that cancer cells in mice are less susceptible to chemotherapy when mouse insulin systems are stimulated by sugar. (9, 10, 11)

h. Regular Exercise - Regular physical activity is important in maintaining good health, helping to reduce stress, and lowering the risk of colon, breast, and possibly lung and endometrial cancers. Physical activity has been shown to improve quality of life among cancer patients in treatment for cancer and studies are being conducted to look at the relationship between physical activity and cancer survival. Previous recommendations for physical exercise were at least 30 minutes per day of moderate physical activity for 5 or more days of the week. However, more recently the U.S. Department of Health and Human Services has recommended at least 1 hour of physical activity per day for children and adolescents and 2.5 hours of moderate intensity aerobic activity for adults each week (or one hour and 15 minutes of vigorous activity each week). In addition, regular physical exercise helps an individual obtain and maintain a normal body weight which lowers the risk of colon, esophageal, renal cell, and postmenopausal breast and uterine cancers.(2)

i. Maintain a Normal Body Weight - According to the National Cancer Institute, it is estimated that 20 %– 30 % of these cancers are related to being overweight and/or lacking physical exercise. Body weight is measured by a body mass index (BMI) which is found by dividing weight (in kilograms) by height (in meters) squared. Normal BMI ranges from 18.5 – 24.9, overweight BMI ranges from 25.0 – 29.9, and obese BMI is anything greater than 30. The trend in the U.S. for adults 20 – 74 years old is for fewer individuals with a normal BMI and for more individuals in the overweight BMI and obese BMI ranges. In 2007-2008 among adults aged 20 and older, 31% of the population was at a healthy weight, 35% were overweight, and 34% were obese. (2)

j. Reduce Stress - Stress is the response of the body to physical, mental, or emotional pressure. There can be positive stress, such as the joy of an upcoming wedding, birth of a baby, and a new job, and there can be negative stress, such as financial crises, death of a loved one, and family problems. When the body is under stress, biochemical interactions within the cell can change. The body releases epinephrine and cortisol which increases heart rate, blood pressure, and blood sugar levels for the fight or flight response. However, if the stress persists or increases over a prolonged period of time, it can increase the risk of disease by leading to unhealthy habits, such as overeating and lack of exercise.

While there is no direct cause and effect relationship between chronic stress and development of cancer, there is an indirect relationship between stress and certain types of viral tumors. Evidence suggests that chronic stress weakens a person's immune system which may affect the incidence of virus-associated cancers. Studies have indicated that stress can affect tumor growth and metastasis but the biological mechanisms are not well understood. It may be that the release of stress hormones directly affects the function of cancer cells or it may be the effects of stress on the immune system affect the growth of tumors or a combination of both.

In theory, everyone makes mutated cells but the immune system is able to detect and destroy these aberrant cells before they can multiply to form a tumor. An increase in unrelieved, long-term stress seems to play a role in reducing the immune system's ability to detect and destroy abnormally growing cells. Animal models suggest that the hormonal response to stress can directly alter processes in cells that help protect against the formation of cancer, such as DNA repair and the regulation of cell growth. Stronger relationships have been found between stress factors and cancer growth and metastasis than between stress and cancer development. (2)

The immune system seems to function the best in individuals who eat a Mediterranean, Indian, or Asian diet and who choose food and beverages which are organically grown so they are free of pesticides and herbicides, who have regular physical activity, who have support of family and friends, and who accept themselves and past history and who face their difficulties. The immune system seems to be inhibited by a traditional Western diet which promotes inflammation, by a sedentary lifestyle, by social isolation, by persistent anger or despair, and by denial of one's true identify. Laughter, serenity, and a clean environment also contribute to enhancing the immune system.

In summary, cancer is the change in normal cells which then can abnormally grow out of control and spread to other sites in the body. It is important to take care of daily health and to be screened for cancer because there is no way of predicting what will happen once one has cancer. Once the cancer is contracted, even after extensive surgery, chemotherapy, and radiation treatments, the same cancer has a possibility of recurring and/or other types of cancer can occur. For instance, a person who has been treated for colorectal cancer and has survived cancer-free for over 5 years can then go on to develop a second primary cancer, like breast cancer, where the pathology report shows that the breast cancer is not a metastatic colorectal cancer in the secondary breast tissue but is actually primary breast cancer. In addition, sometimes the treatment with chemotherapy and/or radiation can cause a 2nd primary cancer to begin. Much is known about cancer and its treatment but much is not known about why cancer develops in some people and not in others, so it is important to decrease risk factors at every turn and have regular screenings.

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