NMNEC Concept: **Cellular Regulation**

Mega Concept: Health and Illness

Category: Homeostasis and Regulation

Concept Name: Cellular Regulation

Concept Definition
Cellular proliferation and the consequences of inappropriate regulation.

Scope and Categories:
- The concept of Cellular Regulation is very broad and can include all aspects of cell functioning. Division and reproduction are expected in all cells, but when growth is uncontrolled, it can result in neoplasia (abnormal and progressive multiplication of cells, leading to the formation of a neoplasm [tumor]), which is the primary focus of this concept.
- Neoplasms can be either benign or malignant based on the following characteristics: encapsulation, differentiation, metastasis, recurrence, vascularity, mode of growth and cell characteristics.

Risk Factors: Impaired cellular regulation affects all individuals, regardless of age, gender, race, or socioeconomic status. Specific types of cancer will have specific associated risk factors (National Cancer Institute, 2018).
Populations at Risk:
- Older adults – 75% of new cancer diagnoses occur in people >55 years old (Centers for Disease Control and Prevention, 2018).
- Genetically susceptible individuals – inherited mutations are thought to play a role in 5% to 10% of all cancers (i.e., *BRCA 1* and *2* – female breast and ovarian, prostate, pancreatic, male breast cancer).
Individual Risk Factors:
- Cigarette smoking/tobacco use – causes cancers of the lung, oral cavity, esophagus, bladder, kidney, pancreas, stomach, cervix, and acute myelogenous leukemia. Cigarette smoking causes 30% of all cancer deaths in the United States.
- Infections – estimated to cause 18% of all cancer cases globally. Human papillomavirus (cancers of the cervix, penis, vagina, anus, oropharynx); hepatitis B virus, hepatitis C virus (liver cancer); Epstein-Barr virus (Burkitt lymphoma); H pylori (gastric cancer).
- Radiation – solar UV (skin cancer); ionizing radiation, including medical radiation, and radon (blood, breast, lung, thyroid cancers).
- Immunosuppression after organ transplantation – cancers linked to viral infections.
Protective/Risk Factors with Probable/Convincing Associations:
- **Protective Factors**

- o Diet – diets high in fruits and non-starchy vegetables associated with probable decreased risk of cancers of mouth esophagus, stomach, lung
- o Physical activity – increased physical activity associated with decreased risk of colorectal cancer, postmenopausal breast and endometrial cancer
- **Risk Factors**
  - o Alcohol – probable increased risk of cancers of mouth, esophagus, breast, colorectum, and liver
  - o Obesity – linked to postmenopausal breast cancer, cancers of esophagus, pancreas, colorectum, endometrium, kidney, gallbladder, and liver
  - o Diabetes – all-cancer incidence and mortality increased 10% to 15% in individuals with diabetes. This is associated with hyperinsulinemia, hyperglycemia, downregulation of sex hormone-binding globulin, and chronic inflammation (National Cancer Institute, 2018)

Physiological Processes and Consequences: Important components include:
- Normal cellular reproduction and growth
  - o Replication and differentiation
- Surveillance of cellular replication and growth
- Abnormal cellular replication and growth
  - o Benign and malignant neoplasm

Assessment:

History: Cancer signs and symptoms vary considerably. Some focused areas to be aware of include:
- A lump or mass may cause unusual or unexplained bleeding, pain, cough, or fatigue. (Also see the 7 early warning signs described in Secondary Prevention.)
- A thorough symptom analysis should be conducted on any presenting symptom
- Family history (particularly of cancers)
- Social habits (tobacco use, alcohol use, sun exposure/protection, etc.)
- Nutrition and exercise habits

Objective:
- Abnormal examination findings may not be present in the early stages of cancer. A thorough assessment will serve as a baseline to detect any changes. Specific examination findings will vary based on the location and size of the neoplasm.

Diagnostic Tests: commonly used tests to detect and diagnose tumors include:

- Radiographic: x-ray, computed tomography (CT) scans, magnetic resonance imaging, ultrasound, radioisotope scans, and mammography

- Direct visualization and/or sampling of suspicious tissue: colonoscopy, endoscopy, sigmoidoscopy
- Labs: complete blood count (CBC) and chemistry panel will indicate overall health status; some genetic/tumor marker tests are available for determining risk (i.e., *BRCA 1* and *2* genes, prostate-specific antigen [PSA])
- Pathology: determines histology, degree of differentiation, and staging through cytology and/or biopsy
    - There are numerous Grading and Staging classification systems available. A common staging system that is used for most cancers is the Tumor Nodes Metastasis (TNM) Classification System (National Cancer Institute, 2015).

(Lewis, Dirksen, Heitkemper, Bucher, and Camera, 2011).

Clinical Management:

Primary Prevention: Health Promotion
- Patient education and community-based interventions are essential for early intervention and prevention. The following factors account for prevention of nearly 60% of all cancers:
    - Regular physical activity
    - Eating a balanced diet
    - Avoiding tobacco use
    - Avoiding excessive sun exposure
- Healthy People 2020 is focusing on reducing cancer risk through:
    - Cancer history
    - Tobacco use
    - Nutrition
    - Weight status
    - Oral health
    - Genomics

(Office of Disease Prevention and Health Promotion, 2018)

Secondary Prevention: Screening
- The goal of secondary prevention is early detection with tests that are reliable, easily detect cancers and are cost effective. The types of screening tests will vary based on the cancer. Some examples are mammogram, colonoscopy, guaiac, and PSA.
- The American Cancer Society advocates teaching about the 7 early warning signs of cancer using the acronym CAUTION:
    - **C**hange in bowel or bladder habits
    - **A** sore that does not heal
    - **U**nusual bleeding or discharge from any body orifice

- o **T**hickening or a lump in the breast or elsewhere
- o **I**ndigestion or difficulty in swallowing
- o **O**bvious change in a wart or mole
- o **N**agging cough or hoarseness
- The screening guidelines vary among the different agencies/organizations, so it may not be possible or recommended to "teach" just one guideline. For example, there are breast cancer screening guidelines available from the American Cancer Society, American Medical Association, World Health Organization, U.S. Preventive Services Task Force

Tertiary Prevention:

Collaborative Care: The goal of cancer treatment (cure, control, or palliation) should be thoroughly discussed with patients and their families, and will guide treatment.

- Primary and/or adjuvant therapy options include:
  - o Surgery
  - o Radiation – internal and/or external
  - o Chemotherapy
  - o Hormonal therapy
  - o Biologic response modifiers
  - o Bone marrow/stem cell transplantation
- Symptom Management
  - o Pain control
  - o Fatigue
  - o Nausea and vomiting
- Body image support
- Grief support

Interrelated Concepts: Essentially, all other concepts can be related to cancer, depending on the type of cancer and circumstances of the patient. The following concepts are closely related for many patients with cancer:

- **Nutrition** can be impacted by reduced or lost appetite, nausea, and stomatitis, resulting in protein-calorie malnutrition.
- **Immunity** can be affected by either the cancer itself or as a consequence of the treatment (chemotherapy, radiation).
- **Infection** is the most common cause of death in cancer patients secondary to reduced functioning of the immune system. Immunodeficiency often masks common signs and symptoms of infection.
- **Comfort:** Pain is the most feared cancer symptom and is often under assessed and undertreated. Cancer-related fatigue is caused by high levels of circulating inflammatory cytokines and is a side effect of chemotherapy, anemia, anorexia, and depression.

- The Psychosocial Concepts of **Stress and Coping** and **Grief** will determine how a patient and family progress and deal with the disease process.
- **Culture** and **Spirituality** also play a key role in how patients and their families understand and cope with a cancer diagnosis.

Model Case:

Pam Allen* is a 65-year-old female with a history of endometrial cancer at age 50. She has since been cancer free. She has been married for 40 years and has a 24 year-old-son with Down's syndrome. Recently, she has had diarrhea with an "odd reddish-brown color and odor." She continued to have problems and describes her stool as sometimes odd-shaped and feels "full," even after defecating.

Physical examination revealed a mass on digital rectal examination and a positive guaiac test. A CBC confirmed that she was anemic and the CT scan identified a mass in the upper rectum and lower colon. She was admitted to the hospital for surgery. She was diagnosed with stage III adenocarcinoma of the colon. The lower colon and upper rectum were removed and a descending colostomy was placed. Because there was lymph node involvement, she received chemotherapy and radiation therapy. She experienced many of the difficult side effects of the treatment.

Several weeks after the treatment was completed, Pam started experiencing more symptoms, and it was discovered that the cancer had metastasized to her liver. After several weeks of trying more chemotherapy, Pam and her husband finally changed their goal of treatment from cure to palliation to make her as comfortable as possible.

Pam's journey through colon cancer exemplifies many of the characteristics of Cellular Regulation. There was no history of receiving a colonoscopy, which highlights the importance of Primary Prevention. She received many of the collaborative treatments and experienced many side effects. Initially, the goal of treatment was curative but was changed to palliation after Pam and her husband finally realized that she could not be cured. Nursing could have played a role throughout Pam's journey, including providing education and treatment/support of physical and emotional needs for both Pam and her family.

* Neighborhood (NBH) character © University of New Mexico College of Nursing.

Exemplars:

New Mexico Nursing Education Consortium (NMNEC) Required Exemplars:
There are > 200 types of cancers but there are many commonalities among the different types. The following 2 types of cancers are "common" and can illustrate the essential components of prevention, diagnosis, and treatment.
- Breast Cancer
    - Breast cancer is the most common cancer among American women, except for skin cancers. About 1 in 8 women (12%) in the United States will develop

invasive breast cancer during their lifetime. Breast cancer is the second leading cause of cancer death in women, exceeded only by lung cancer. At this time there are more than 3.1 million breast cancer survivors in the United States (American Cancer Society, 2019).

- Colon Cancer
    - o Of cancers affecting both men and women, colorectal cancer is the second leading cancer killer in the United States. In 2007, 142,672 Americans were diagnosed with colorectal cancer. It is estimated that as many as 60% of colorectal cancer deaths could be prevented if all men and women aged 50 years or older were screened routinely (Centers for Disease Control and Prevention, 2018).

Optional Exemplars:
- Lung cancer – most common incidence and mortality of cancers of both men and women
- Prostate cancer – most common incidence
- Leukemia – most common cancer in childhood

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Resources:

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